FORM PTO-1390
(REV 10-97)

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

DATE: March 23, 1999

EXPRESS MAIL LABEL NO.
EM395347374US

ATTORNEY DOCKET NO.
34248/DBP

U.S. APPLICATION NO.
To Be Assigned 09/147970

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/DE97/02363	**7-October-1997**	**7-October-1996**

TITLE OF INVENTION
METHOD FOR TRANSMITTING DATA IN A TELECOMMUNICATIONS NETWORK AND SWITCH FOR IMPLEMENTING SAID METHOD

APPLICANT(S) FOR DO/EO/US
SCHINDLER Sigram; ILLG Andreas; LÜDTKE Karsten; and PAETSCH Frank

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.

5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2)).
    a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).
    b. ☒ has been transmitted by the International Bureau.
    c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/LUS).
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).

7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)).
    a. ☒ are transmitted herewith (required only if not transmitted by the International Bureau).
    b. ☒ have been transmitted by the International Bureau.
    c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
    d. ☐ have not been made and will not be made.

8. ☒ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).

9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).

10. ☒ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items below concern other document(s) or other information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.

12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.

13. ☐ A FIRST preliminary amendment.
    ☐ A SECOND or SUBSEQUENT preliminary amendment.

14. ☐ A substitute specification.

15. ☐ A change of power of attorney and/or address letter.

16. ☒ Small entity claim with a copy of this transmittal letter attached.

17. ☒ International search report.

18. ☒ International preliminary examination report.

19. ☒ Extra set of drawings

20. ☒ Letter re Correction to Drawings

21. ☒ English Translation of FIGS. 5a and 5b

U.S. APPLICATION NO. (If known, see 37 CFR 1.5) To Be Assigned	INTERNATIONAL APPLICATION NO. PCT/DE97/02363	ATTORNEY DOCKET NO. **34248/DBP**	

	CALCULATIONS	PTO USE ONLY

☒   The following fees are submitted: (see Note (1) below)

Basic National Fee (37 CFR 1.492(a)(1)-5)):

Search Report has been prepared by the EPO or JPO . . . .**$ 840.00**

International preliminary examination fee paid to USPTO (37 CFR 1.482) . . . . . **$ 670.00**

No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) . . . . **$ 760.00**

Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO . . . . **$ 970.00**

International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) . . . . **$ 96.00**

	CALCULATIONS	PTO USE ONLY
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 840.00	
Surcharge of **$130** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$	

Claims	Number Filed	Number Extra	Rate		
Total Claims	21+4 -20=	5	X $18	$ 90.00	
Independent Claims	2 -3=	0	X $78	$ 0.00	
Multiple dependent claim(s) (if applicable)			+ $260	$ 260.00	
TOTAL OF ABOVE CALCULATIONS =				$ 1,190.00	
Reduction by 1/2 for filing by small entity, if applicable. Verified Small entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).				$ 595.00	
SUBTOTAL =				$ 595.00	
Processing fee of **$130** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				$	
TOTAL NATIONAL FEE =				$ 595.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property				$	
TOTAL FEES ENCLOSED =				$ 595.00	

Note (1): The basic national fee must be paid when filing this application. The 20-month time limit (37 CFR § 1.494) and 30-month time limit (37 CFR § 1.495) are not extendable.	Amount to be: refunded	$
	charged	$

a. ☒   A check in the amount of **$ 595.00** to cover the above fees is enclosed.

b. ☐   Please charge my Deposit Account No. _____ in the amount of $ _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒   The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **03-1728**. A duplicate copy of this sheet is enclosed.

NOTE (2): Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

D. Bruce Prout
CHRISTIE, PARKER & HALE
P.O. Box 7068
Pasadena, CA 91109-7068

By _~D. Bruce Prout~_

D. Bruce Prout
Reg. No. 20,958

SFC PAS177582.1-*-3/22/99 10 37 am

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

This paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" under 37 CFR § 1.10 Mailing Label No. EL280433895US.

Applicant   : Sigram Schindler et al.
Application No. : 09/147,970
Filed   : March 23, 1999
Title   : METHOD FOR TRANSMITTING DATA IN A
                     TELECOMMUNICATIONS NETWORK AND SWITCH FOR
                     IMPLEMENTING SAID METHOD

Grp./Div.   : Unknown
Examiner   : Unknown

Docket No.   : 34248/DBP/M521

REQUEST FOR APPROVAL OF DRAWING CHANGE

                                          Post Office Box 7068
Assistant Commissioner for Patents   Pasadena, CA 91109-7068
Washington, D.C. 20231   April 30, 1999

Commissioner:

Please amend Fig. 2 as indicated to indicate a plurality of IP switches 10 in the attached redlined drawing.

Please replace Fig. 5A and Fig. 5B with the enclosed new Figures 5A and 5B. English translation for the text of the Figures 5A and 5B have been incorporated therein to aid with examination.

Enclosed herewith are two copies of Figures 2, 5A and 5B, showing in red the proposed changes. It is requested that these

drawing changes be reviewed and approved by the Examiner. Applicant will formalize the drawings after allowance of the application.

Respectfully submitted,

CHRISTIE, PARKER & HALE, LLP

By _____

J. Edwin Jeon

Reg. No. 43,693

626/795-9900

DBP/sfc

Enclosures: Two copies of drawings FIGs. 2, 5A, 5B

AJD PAS183712.1-*-4/30/99 5:52 pm

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

This paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" under 37 CFR § 1.10 Mailing Label No. EM395347374US.

Applicant   : Sigram Schindler et al.
Application No. : To Be Filed
Filed   : To Be Filed
Title   : METHOD FOR TRANSMITTING DATA IN A
                          TELECOMMUNICATIONS NETWORK AND SWITCH FOR
                          IMPLEMENTING SAID METHOD

Grp./Div.   : Unknown
Examiner   : Unknown

Docket No.   : 34248/DBP/M521

LETTER RE CORRECTION TO DRAWINGS

Assistant Commissioner for Patents
Washington, D.C. 20231

Post Office Box 7068
Pasadena, CA 91109-7068
March 22, 1999

Commissioner:

Please amend FIG. 2 by adding --PRIOR ART-- as indicated in the attached redlined drawing.

Respectfully submitted,

CHRISTIE, PARKER & HALE, LLP

By _____
D. Bruce Prout
Reg. No. 20,958
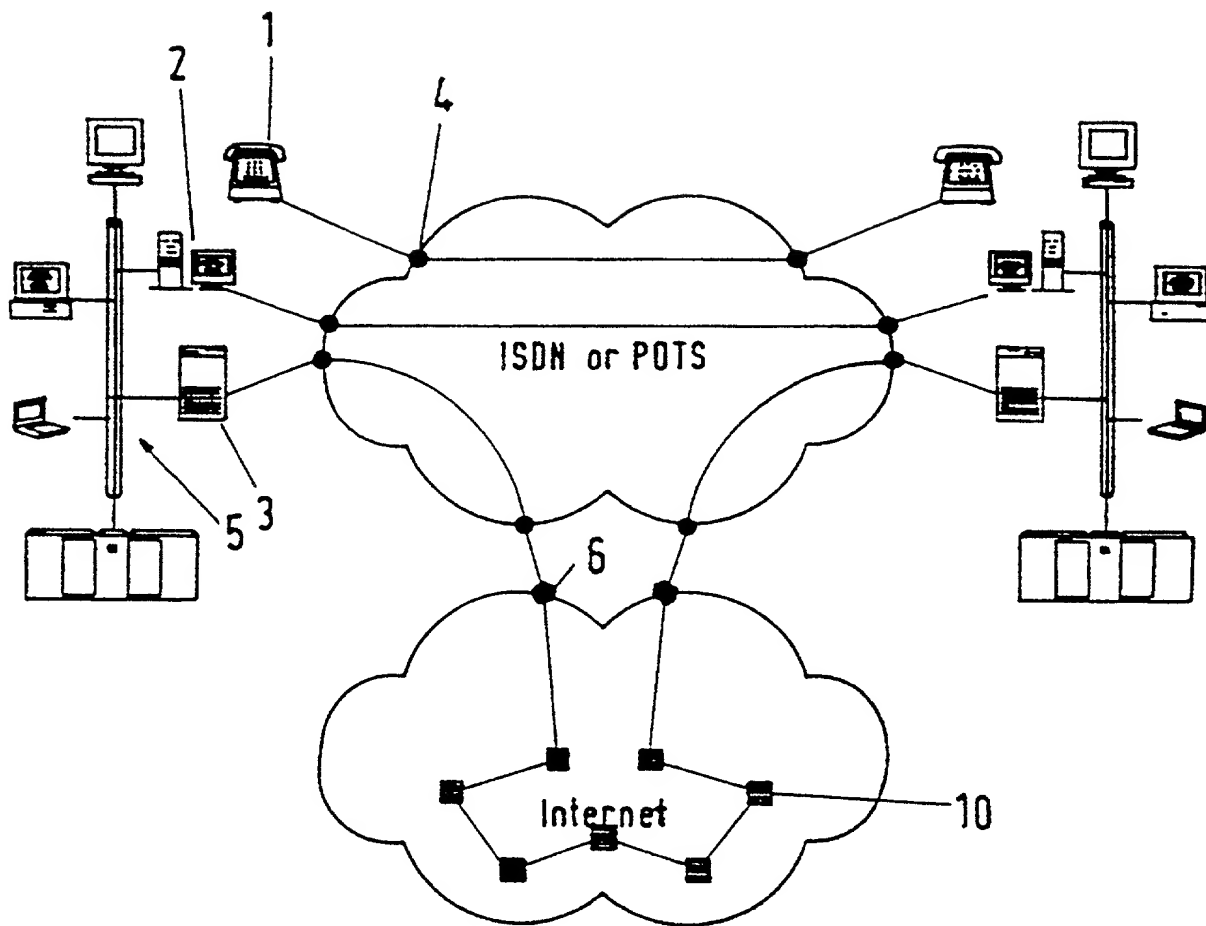626/795-9900

DBP/sfc
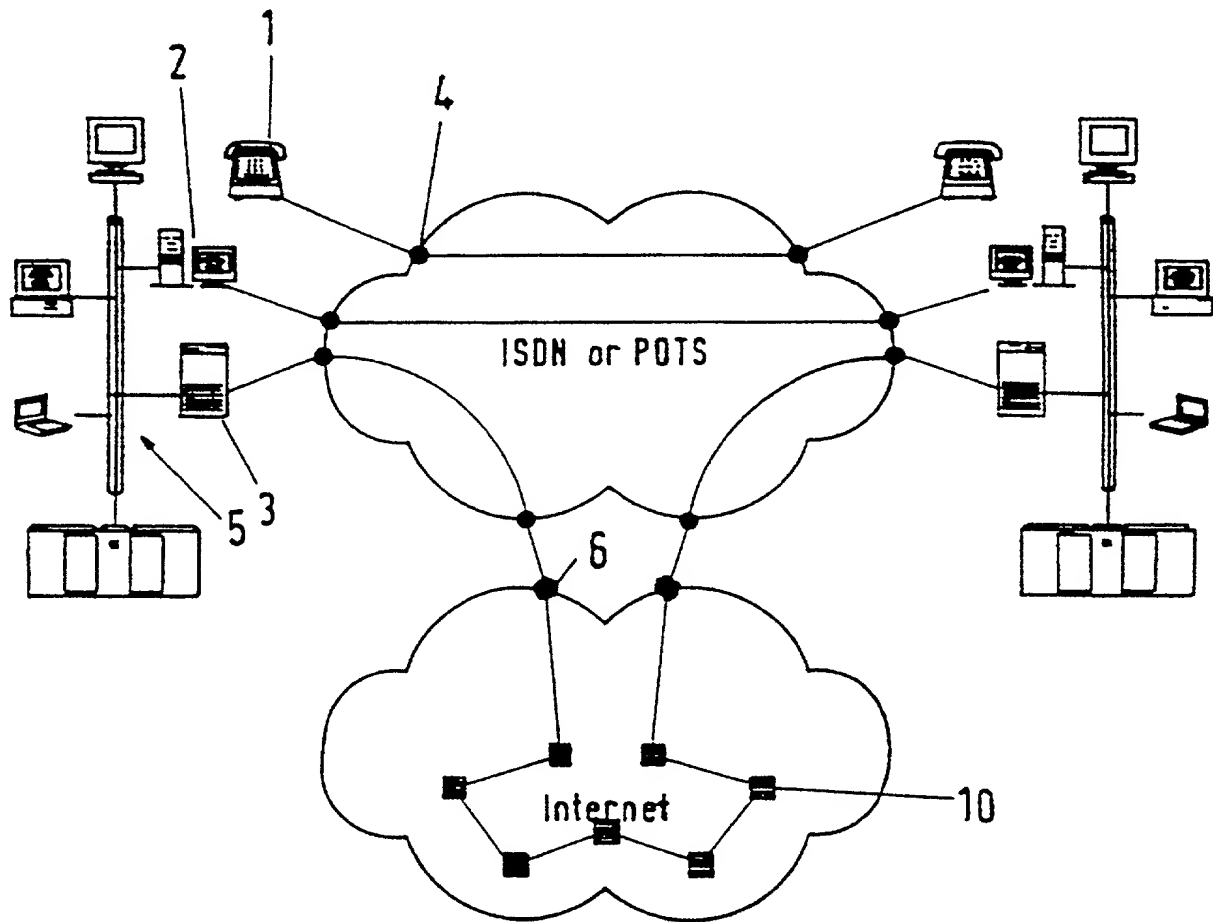SFC PAS177706.1-*-3/22/99 4:35 pm

Fig.2

PRIOR ART

Fig.2

Docket No.	: 34248/DBP/M521	CHRISTIE, PARKER & HALE, LLP
		Post Office Box 7068
Applicant or Patentee	: Sigram SCHINDLER et al.	Pasadena, CA 91109-7068
Application or Patent No.	: **To Be Assigned**	(626) 795-9900
Filed or Issued	: To Be Assigned	
Entitled	: METHOD FOR TRANSMITTING DATA IN A TELECOMMUNICATIONS	
	NETWORK AND SWITCH FOR IMPLEMENTING SAID METHOD	

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS
(37) CFR 1.9(f) & 1.27(c) – SMALL BUSINESS CONCERN

I hereby declare that I am

_____   the owner of the small business concern identified below:

__X__   an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF SMALL BUSINESS CONCERN   :   Teles AG Informationstechnologien

ADDRESS OF SMALL BUSINESS CONCERN: Doverstraße 2-4, 10587 Berlin, Germany

I hereby declare that the above identified small business concern qualifies as a small business concern as defined in 13 CFR 121.12, and reproduced in 37 CFR 1.9(d), for the purposes of paying reduced fees to the United States Patent and Trademark Office, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention entitled **METHOD FOR TRANSMITTING DATA IN A TELECOMMUNICATIONS NETWORK AND SWITCH FOR IMPLEMENTING SAID METHOD** by inventor(s) **Sigram SCHINDLER, Andreas ILLG, Karsten LÜDTKE, and Frank PAETSCH** described in

__X__   the specification filed herewith

_____   Application No. __ filed __

_____   Patent No. __ issued __

If the rights held by the above identified small business concern are not exclusive, each individual, concern or organization having rights in the invention is listed below* and no rights to the invention are held by any person, other than the inventor, who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d), or a nonprofit organization under 37 CFR 1.9(e). *NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

NAME   :
ADDRESS :
          ___ INDIVIDUAL   ___ SMALL BUSINESS CONCERN   ___ NONPROFIT ORGANIZATION

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS
(37) CFR 1.9(f) & 1.27(c) – SMALL BUSINESS CONCERN

Docket No.: 34248/DBP/M521

NAME   :
ADDRESS :

___ INDIVIDUAL   ___ SMALL BUSINESS CONCERN   ___ NONPROFIT ORGANIZATION

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING   : Prof. Dr.-Ing. Sigram Schindler, Dr. Stefan Jiranek
TITLE OF PERSON IF OTHER THAN OWNER : CEO   COO
ADDRESS OF PERSON SIGNING   : Inselstr. 24, 14129 Berlin   ; Eberfelder Str. 24a
                                                                                14612 Falkensee
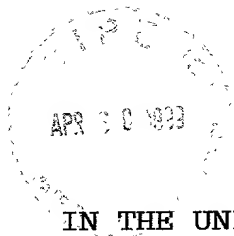
SIGNATURE _____ DATE ___17-3.89___

DBP/sfc
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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

This paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" under 37 CFR § 1.10 Mailing Label No EL280433895US.

Applicant	:	Sigram Schindler et al.
Application No.	:	09/147,970
Filed	:	March 23, 1999
Title	:	METHOD FOR TRANSMITTING DATA IN A TELECOMMUNICATIONS NETWORK AND SWITCH FOR THE IMPLEMENTATION OF THE METHOD
Grp./Div.	:	Unknown
Examiner	:	Unknown
Docket No.	:	34248/DBP/M521

PRELIMINARY AMENDMENT

Post Office Box 7068
Assistant Commissioner for Patents   Pasadena, CA 91109-7068
Washington, D.C. 20231   April 30, 1999

Commissioner:

Please amend the above-identified application as follows:

IN THE CLAIMS

Please amend claims 1-21 as follows:

1   1.   (Amended) <u>A method</u> [Method] for transferring data <u>from an</u>
2   <u>end terminal,</u> from a first switch to a second switch which are part
3   of a line-switching network <u>managed by a network management system</u>
4   or have access to <u>the</u> [a] line-switching network, selectively by
5   line-switching or packet-switching, <u>comprising</u> [consisting of] the
6   [following] steps <u>of</u>:
7   a)   establishing a connection through the line-switching
8   network from <u>the</u> [a] first switch to an access point of
9   a packet-switching network;

-1-

10 b)   line-switching transferring [transfer] of data through
11   said connection from the first switch to the access point
12   of the packet-switching network;

13 c)   packeting of the data into data packets if [this does]
14   the data do not yet exist as data packets, and packet-
15   switching transferring [transfer] of the data packets
16   through the packet-switching network from the access
17   point to the second switch;

18 d)   checking repeatedly [repeated checks] whether a control
19   signal exists which is triggered by [the] a user of the
20   [an] end terminal or the network management system for
21   changing-over [transferring] to a line-switching
22   connection to the second switch;

23 e)   establishing the [a] line-switching connection, during an
24   existing transfer, from the first switch to the second
25   switch through the line-switching network with a [the]
26   presence of [a corresponding] the control signal, if
27   [this] the line-switching connection is not yet present;

28 f)   changing-over to a line-switching data transfer during
29   the existing [connection] transfer and transferring data
30   over the line switching connection to the second switch.

1   2.   (Amended) A method [Method] for transferring data from an
2   end terminal, from a first switch to a second switch both of which
3   are [both] part of a line-switching network and a packet-switching
4   network, both managed by a network management system, and have
5   access to such networks, selectively through line-switching or
6   through packet-switching, comprising [consisting of] the
7   [followings] steps of:

8   a)   packeting the data into data packets in the first switch
9   if the data does not yet exist as data packets;

10 b) packet-switching transferring [transfer] of the data
11   packets through the packet-switching network to the
12   second switch;
13 c) checking repeatedly [repeated checking] whether a control
14   signal exists which is triggered [released] by a [the]
15   user of the [an] end terminal or [a] the network
16   management system for transferring to a line-switching
17   connection to the second switch;
18 d) establishing the [a] line-switching connection, during an
19   existing transfer, through the line-switching network to
20   the second switch with [the] a presence of [a
21   corresponding] the control signal, if [this] the line-
22   switching connection is not yet present;
23 e) [f)] changing-over [change] to a line-switching data
24   transfer during the existing [connection] transfer
25   and transferring data over the line switching
26   connection to the second switch.

3. (Amended) The method [Method] according to claim 1 or 2
wherein the data packets after changing over to [a] the line-
switching data transfer remain as data packets and are transferred
as such by line-switching.

1   4. (Amended) The method [Method] according to claim 1 or 2
2   wherein the data packets after changing to [a] the line-switching
3   data transfer are unpacketed, more particularly [the] headers of
4   the data packets are removed.

1   5. (Amended) The method [Method] according to claim 1 [at
2   least one of claims 1, 3 or 4] wherein a [the] same data channel is
3   used to send the data packets to the access point to the packet-
4   switching network and to transfer the data through the line-
5   switching network to the second switch.

1 6.   (Amended) <u>The method</u> [Method] according to <u>claim 1</u> [at
2 least one of claims 1, 3 or 4] wherein data packets are transferred
3 to the access point to the packet-switching network through a first
4 data channel and the data are transferred for line-switching to the
5 second switch through a second data channel.

1 7.   (Amended) <u>The method</u> [Method] according to <u>claim 1 or 2</u>
2 [at least one of the preceding claims] wherein the line-switching
3 network is an ISDN network [with] <u>having</u> ISDN switches, the data
4 packets have [the format] <u>a</u> TCP/IP <u>format</u> and [the] data channels
5 used for <u>the</u> line-switching data transfer [represent] <u>are</u> ISDN B
6 channels.

1 8.   (Amended) <u>The method</u> [Method] according to <u>claim 1 or 2</u>
2 [at least one of the preceding claims] wherein the control signal
3 which [releases] <u>triggers</u> a <u>change-over</u> [change] between the line-
4 switching <u>transfer</u> and <u>the</u> packet-switching transfer [on
5 understepping or exceeding certain demands on the quality of the
6 data transfer such as time delay or noise proportion,] is produced
7 automatically <u>when demands on a quality of a data transfer such as</u>
8 <u>a time delay or a noise proportion is understepped or exceeded</u>, or
9 <u>produced</u> as a result of a command of [a] <u>the</u> network management
10 system or [an] <u>the</u> end <u>terminal</u> [appliance].

1 9.   (Amended) <u>The method</u> [Method] according to <u>claim 1</u> [at
2 least one of the preceding claims] wherein<u>,</u> with [a] <u>the</u> line-
3 switching data transfer between the first switch and the second
4 switch or between the first switch and the access point to the
5 packet-switching network<u>,</u> the data of several users are multiplexed
6 on one data channel by forming sub-channels of <u>a</u> fixed <u>bandwidth</u>
7 [band width].

1   10.   (Amended) <u>The method</u> [Method] according to claim 9
2 wherein the data of [one] <u>the</u> user [after its selection] <u>when line-</u>
3 <u>switching is selected,</u> are transferred line-switched with a
4 transfer rate which corresponds to a fraction of the transfer rate
5 of <u>a</u> [the] <u>bandwidth</u> [band width] which is available as standard to
6 the user.

1   11.   (Amended) <u>The method</u> [Method] according to claim 9 or 10
2 wherein the <u>line-switching</u> [line-switched] network is an ISDN
3 network and the data of [one] <u>the</u> user to be transferred are
4 transferred between the <u>first and the second</u> switches or <u>between</u>
5 [one] <u>the first</u> switch and the access point to the packet-switching
6 network on [one] <u>a</u> data channel with a <u>bandwidth</u> [band width] which
7 [corresponds to] <u>is only</u> a fraction of <u>a standard</u> [the] <u>bandwidth</u>
8 [band width] of 64 kbit/s [which is available as standard], more
9 particularly 32, 16, 8, 4, 2 or 1 kbit/s.

1   12.   (Amended) <u>The method</u> [Method] according to claim 11
2 wherein<u>,</u> in the <u>first</u> switch<u>,</u> only [each] <u>every</u> n-th byte or <u>every</u>
3 [each] n-th bit of an ISDN frame is copied over and forwarded on
4 [the] <u>a</u> [switched-through] data channel to the [next] <u>second</u> switch
5 or to [an] the access point to the packet-switching network<u>,</u>
6 whereby <u>an effective</u> [the] <u>bandwidth</u> [band width] of the <u>line-</u>
7 <u>switching data</u> transfer is [64 kbit/s /n] <u>(64/n) kbit/s</u>.

1   13.   (Amended) <u>The method</u> [Method] according to <u>Claim 1 or 2</u>
2 [at least one of the preceding claims] wherein<u>,</u> with <u>a data</u>
3 <u>transfer from the first switch changing over</u> [a change-over] from
4 a packet-switching <u>data</u> transfer to [a] <u>the</u> line-switching <u>data</u>
5 transfer<u>,</u>
6   a)   <u>an</u> [the] address information of the data packets are
7   evaluated and classified according to <u>a</u> network
8   topology[;]<u>, and</u>

9   b)   for the data packets whose destination addresses [relate]

10   corresppond to [the] a same topological area of the

11   network [a] , the second switch is selected which is

12   located in [this] the same topological area[;]

13   [c]   a line-switching connection (bypass) is established with

14   the selected switch, and]

15   [d]   the corresponding data or data packets are transferred

16   line-switched to the switch].

1   14.   (Amended) The method [Method] according to claim 13

2 wherein, [characterized in that] to classify the data packets

3 according to the network topology, the destination addresses of the

4 data packets are sorted according to geographical areas whereby,

5 for data packets whose destination addresses correspond [relate] to

6 [the] a same geographical area, [a] the second switch is selected

7 [which is] to be located in this geographical area [and a line-

8 switching connection is established with this switch].

1   15.   (Amended) The method [Method] according to claim 14

2 [characterized in that] wherein, for classifying the data packets

3 according to geography, the destination addresses are compared with

4 destination addresses stored in a data bank [whereby the data band]

5 which contains a link between the destination addresses and [the]

6 associated [geographic situation] geographical areas.

1   16.   (Amended) [Method according to at least one of the

2 preceding claims wherein in corresponding manner during an existing

3 connection a change is made between a line-switching and a packet-

4 switching transfer.] The method according to claim 1, when the data

5 is being transferred using the line-switching data transfer,

6 further comprising the steps of:

7   a)   checking repeatedly whether a second control signal

8   exists which is triggered by the user of the end terminal or

9   the network management system for changing-over to a packet-
10 switching data transfer to the second switch;

11   b)   establishing a second connection through the line-
12 switching network, during the existing transfer, from the
13 first switch to the access point of the packet-switching
14 network with a presence of the second control signal, if the
15 connection to the access point is no longer present;

16   c)   changing-over to a packet-switching data transfer
17 during the existing transfer;

18   d)   line-switching transferring of the data through the
19 connection or the second connection from the first switch to
20 the access point; and

21   e)   packeting of the data into data packets if the data
22 does not yet exist as data packets, and packet-switching
23 transferring of the data packets through the packet switching
24 network from the access point to the second switch.

1   17.   (Amended) A switch [Switch] for use in a method according
2   to claim [claims] 1 or 2, [with] comprising: a control device; at
3   least one packeting device [(713, 714)] for packeting and
4   unpacketing data[,]; a packet switching device [(72)] for routing
5   data packets; and a line-switching device [(73)] for establishing
6   connections of data channels,[characterized by] wherein [a] the
7   control device [(71) which] directs incoming data either to the
8   packet switching device [(72)] or to the line switching device
9   [(73)] depending [in dependence] on the control [signals] signal
10 [of a] triggered by the user of [an] the end terminal or the [a]
11 network management system.

1   18.   (Amended) The switch [Switch] according to claim 17
2   [characterized in that] further comprising a topology data bank
3   [(75) is provided_which contains] containing associations between

4   destination addresses of <u>the</u> data packets and associated

5   geographical <u>areas</u> [origin].

1   19. (Amended) <u>The switch</u> [Switch] according to claim 17 [or

2   18] <u>further comprising</u> [characterized in that furthermore] a

3   multiplexer [(732) is provided] which<u>,</u> with the presence of a

4   corresponding control command<u>,</u> multiplexes several data streams so

5   that only [each] <u>every</u> n-th bit and/or [each] <u>every</u> n-th byte is

6   used in [the] <u>an</u> outgoing data channel.

1   20. (Amended) <u>The switch</u> [Switch] according to claim 19

2   [characterized in that] <u>wherein</u> different input data streams occupy

3   different sized proportions in the outgoing data channel.

1   21. (Amended) <u>The switch</u> [Switch] according to <u>claim 17</u>

2   <u>further comprising</u> [one of claims 17 to 20 characterized in that in

3   addition] a device [(721) is provided] for compressing and

4   decompressing data.

Please add the following new claims:

1   -- 22. The method according to claim 2 wherein, with the line-

2   switching data transfer between the first switch and the second

3   switch, the data of several users are multiplexed on one data

4   channel by forming sub-channels of a fixed bandwidth. --

1   -- 23. The method according to claim 22 wherein the data of the

2   user when line-switching is selected, are transferred line-switched

3   with a transfer rate which corresponds to a fraction of the

4   transfer rate of a bandwidth which is available as standard to the

5   user. --

1   -- 24. The method according to claim 22 or 23 wherein the line-
2   switching network is an ISDN network and the data of the user to be
3   transferred are transferred between the first and the second
4   switches on a data channel with a bandwidth which is only a
5   fraction of a standard bandwidth of 64 kbit/s, more particularly
6   32, 16, 8, 4, 2 or 1 kbit/s. --

1   -- 25. The method according to claim 24 wherein, in the first
2   switch, only every n-th byte or every n-th bit of an ISDN frame is
3   copied over and forwarded on a data channel to the second switch,
4   whereby an effective bandwidth of the line-switching data transfer
5   is (64/n) kbit/s. --

6   -- 26. The method according to claim 2, when the data is being
7   transferred using the line-switching data transfer, further
8   comprising the steps of:
9   a) checking repeatedly whether a second control signal
10   exists which is triggered by the user of the end terminal or the
11   network management system for changing-over to a packet-switching
12   data transfer to the second switch;
13   b) changing-over to a packet-switching data transfer
14   during the existing transfer with a presence of the second control
15   signal; and
16   c) packeting the data into data packets in the first
17   switch if the data does not yet exist as data packets, and packet-
18   switching transferring of the data packets through the packet-
19   switching network to the second switch. --

1   -- 27. A switch comprising:
2   a control device;
3   at least one packeting device for packeting and
4   unpacketing data;
5   a packet switching device for routing data packets; and

6   a line-switching device for establishing connections of
7   data channels,

8   wherein a control device directs incoming data either to
9   the packet switching device or to the line switching device
10 depending on a control signal triggered by a user of an end
11 terminal or a network management system. --

1   -- 28. The switch according to claim 27 further comprising a
2   topology data bank containing mapping information between
3   destination addresses of the data packets and geographical areas.
4   --

1   -- 29. The switch according to claim 27 or 28, further
2   comprising a multiplexer, wherein the incoming data comprise
3   several input data streams and the multiplexer, responding to a
4   presence of a control command, multiplexes said several input data
5   streams so that only every n-th bit and/or every n-th byte of each
6   one of said several input data streams is used in an outgoing data
7   channel. --

1   -- 30. The switch according to claim 29 wherein the multiplexer
2   assigns differently sized proportions in the outgoing data channel
3   to different ones of said several input data streams. --

1   -- 31. The switch according to claim 27 or 28 further comprising
2   a device for compressing and decompressing the data packets. --

REMARKS

Claims 1-21, as amended, remain in this application. Claims 22-31 have been added. Figures 2, 5A and 5B have been amended. It is respectfully requested that the foregoing Preliminary Amendment be entered prior to examination.

Amendments have been made to the specification. Due to the number of amendments, a substitute specification pursuant to 37 CFR § 1.125 and MPEP § 608.01 (q) is submitted herewith to facilitate the prosecution of this application. The substitute specification is accompanied by a copy of the original specification as filed with the annexes incorporated therein and a compare document showing the changes between the original specification and the substitute specification. The substitute specification does not contain any new matter and includes the same changes as are indicated in the compare copy. Applicant respectfully requests that the substitute specification be entered in this case.

In view of the foregoing amendments and remarks, consideration and allowance of this application are respectfully requested.

Respectfully submitted,

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626/795-9900

JEJ/jej
Enclosures: Specification as filed (with annexes incorporated)
                Substitute Specification
                Compare Document

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Applicant   :   Sigram Schindler et al.
Application No   :   09/147,970
Filed   :   March 23, 1999
Title   :   METHOD FOR TRANSMITTING DATA IN A
                      TELECOMMUNICATIONS NETWORK AND SWITCH
                      FOR IMPLEMENTING SAID METHOD
Docket No.   :   34248/DBP/M521

SUBSTITUTE SPECIFICATION

METHOD FOR TRANSMITTING DATA IN A TELECOMMUNICATIONS NETWORK
AND SWITCH FOR IMPLEMENTING SAID METHOD

5

BACKGROUND OF THE INVENTION

The invention relates to a method for transferring data from a first switch to a second switch, selectively by line switching or by packet switching, and to a switch for carrying out the

10   method.

The present-day situation in telecommunications is marked by a division between two different connecting and switching technologies. These are the synchronous line-switching technology (line-switching or circuit switching) and asynchronous

15   packet-switching technology (packet-switching).

Line-switching connections use line switches, alias line switching equipment, between the individual line sections, each of which copies over 1 byte packets and has a corresponding buffer size. Packet-switching connections use packet switches,

20   alias packet switching equipment, between the individual line sections of a network, each of which copies over multi-byte packets. The buffer size of a packet switch correspondingly amounts to n bytes where n stands for the number of bytes in the copied data packets. The term "switch" is used below so that it

25   includes both a line switch of a line switching network and a packet switch of a packet switching network.

A line switch, alias line switching equipment, is called telecommunications apparatus (TK apparatus) in the private sector, and exchanges of the network supplies in the public

30   sector. A packet switch, alias packet switching apparatus, is also called a router, an IP switch or a host computer.

Line switching connections are synchronous, i.e., data transfer is carried out substantially without any time delay from one line section to an adjoining line section through a switch

35   (here, a line switching apparatus).

When a line-switching call is put through, a connection is continually provided in real time with the complete bandwidth of a channel between two points. Even if no useful information is being sent e.g., during a pause in telephone conversation, the transmission channel is occupied or engaged. Line-switching connections are expensive, particularly during telephone conversations since the costs accumulate irrespectively of the information actually transferred. The advantage of a line switching connection is that it is free of any time delay and has a fixed bandwidth.

The other important type of data exchange nowadays is the packet exchange. With packet exchange, data, e.g., audio data, video data or computer files, are packeted and transferred as data packets. Packet switching works in the asynchronous transfer mode, i.e., data is transferred time-delayed between two adjoining line sections by a switch (here, a packet switching apparatus). In the case of packet-switching exchanges, and quite differently from line-switching exchanges, a fixed connection does not have to be maintained. It is connection-less, i.e., each packet is treated individually and not in conjunction with others.

Packet switching is used in particular on the Internet. The data packets are termed there as IP packets (IP = Internet Protocol). Each IP packet contains a header which contains, inter alia, sender and receiver addresses. The IP packets form a data flow which is transferred through packet switching apparatus (alias IP switches or Routers or Host computers) in the Internet from the sender to the relevant receiver.

As a result of the length of the IP packets (16 bytes or more), a time delay occurs in the packet switching apparatus when copying. This time delay can be so great, when there is a heavy load on the packet switching apparatus which passes a data packet

over the route to the destination address, that certain applications are no longer possible.

5   These delays are of considerable significance particularly in the case of the Internet. With Internet telephony, a cost-conscious caller uses the normal Internet with approximately 8 kbit/s bandwidth and a time delay of 0.5 seconds. When the Internet is overloaded, the time delay of the individual packets

10   becomes so great that an acceptable conversation connection between telephone partners is no longer possible.

Internet telephony is marked by a great advantage that only the relevant local telephone charges to the next POP (Point of Presence), the access point to the Internet offered by an

15   Internet Service Provider ISP, as well as time charges calculated by the ISPs for the length of the Internet access as well as volume charges, but not expensive long distance telephone charges are incurred.

From US patent no. 4,996,685 a method and device are known

20   which allow in an ISDN communications network, during an existing connection between a user and a host computer, a dynamic change between a line switching connection through an ISDN B channel and a packet-switching connection through an ISDN D channel. A command to change between a line-switching and a packet-switching

25   connection thereby always emanates from the Host computer.

The method disclosed in US patent no. 4,996,685 is restricted to undertaking on an ISDN connection a change between a line-switching and a packet-switching data transfer whereby a line-switching transfer is carried out on a B channel and a

30   packet-switching transfer is carried out on the D channel. A method of this kind is indeed expedient to produce effective access from an end subscriber to a host computer, possibly an exchange point of the telephone network or an access point to the internet, but does not relate to the transfer of data between

35   switches or routers of a network.

WO 95/31060 Al describes a method for transferring data between an information source and a destination device wherein
5   the data to be transferred are transferred as data packets. Depending on type of information of the data packets, the data are transferred automatically either solely by line-switching or solely by packet-switching. More particularly in the case of small amounts of data to be transferred, a packet-switching
10   transfer is chosen and in the case of large amounts of data, a line-switching data transfer is chosen.

WO 95/25407 Al describes a method for transferring data between a data source and transceiver either through a packet-switching network or a line-switching network. A control device
15   is thereby provided which uses certain criteria to decide which network and which method of transfer is best suited for the transfer and then selects same.

US patent no. 4,903,260 describes a digital coupling network and a coupling field chip which are designed so that paths
20   leading from any input to any output can, depending on requirements, either be switched through for line-switching connections or can be preset for packet-switching information. Preset paths for the packet-switched information thereby form a network whose junctions lie in the coupling field chip of the
25   coupling network. Those function devices which are required to send each data packet on the path preset for same are integrated in the coupling field chips. It is thus possible to divide up a single coupling network depending, on requirements, dynamically into a line-switching network and a packet-switching network.
30

SUMMARY OF THE INVENTION
Based on the prior art, the present invention is concerned with the problem of providing a method for transferring data from a first switch to a second switch and providing a switching for
35   carrying out the method which, depending on the data origin and

headers of a user or network management system, allows flexible data transfer between the switches and more particularly cost-

5   effective data transfer with real time properties.

The solution according to the present invention makes it possible during pocket-switching connection between two switches to achieve a dynamic change-over to line-switching connection without interrupting the connection. This is always advisable if

10 a data build up of data packets exists before the switches of the packet-switching network. Through the establishment of a line-switching connection between the switches, a bypass is produced according to the invention on which data can be transferred with fixed bandwidth and slight time delays substantially in real time

15 so that the data blockage is bypassed. Since a line switching connection is established only when required, i.e., when a packet-switching data transfer no longer has the desired bandwidth, the invention allows a flexible, most cost-effective data transfer.

20 The term "switch" is used in the sense of the present invention as already explained so that it includes both a line-switch of a line-switching network which copies over 1-byte packets, and a packet-switch (router) of a packet-switching network which copies over multi-byte packets. Data to be

25 transferred can be any type of data, such as audio data, video data or computer files.

The present invention provides for carrying out the method according to the present invention, on switches which allow both line-switching and packet-switching, and combine the functions

30 of a line-switch and a packet-switch. A switch according to the present invention has a packeting device for packeting and unpacketing data, an IP switching device for routing data packets, a line-switching device for establishing connections for switching through data channels and a control device which

35

directs incoming data either to the IP switching device or to the line switching device depending on the control signals.

5   The corresponding control signals are triggered by a user, or at the command of a network management system and are transferred together with other signaling data to the switch. Alternatively, the switch itself automatically produces a corresponding control command upon exceeding a certain bandwidth

10 of the packet-switching transfer.

The network which consists of interconnected switches according to the present invention forms an Intranet wherein data transfer can be interchanged dynamically between line switching and packet switching and ensures, under normal conditions, data

15 transfer substantially in real time through the possibility of establishing when required, a line-switching connection of a fixed bandwidth. This is particularly important for internet telephony.

There are numerous useful areas for the switches according

20 to the present invention. The switches according to the present invention can even replace conventional line-switches such as TK equipment and exchanges as well as packet switches. More particularly they can be used to build up new networks with real time capacity (intranets) which can operate both by line-

25 switching and by packet-switching.

The method according to the present invention is used in a first embodiment of the invention between two switches which are part of a line-switching network, but not directly part of a packet-switching network. Therefore, for a packet-switching

30 transfer, first a connection is established through the line-switching network from a first switch to an access point to the packet-switching network (such as Internet access point). The data are transferred line-switched to the access point to the packet-switched network, where they are packeted if they do not

35 already exist as packets, and are transferred from the access

point packet-switched through the packet-switching network to the second switch. The data are thereby preferably already packeted

5   in the first switch and transferred as data packets line-switched to the access point.

If both switches are part of both a line-switching network and a packet-switching network, then in a second embodiment of the method according to the present invention, a packet-switched

10   data transfer can take place directly between the switches. With both embodiments, with a presence of a corresponding control signal, a line-switching connection is built up through the line-switching network directly to the second switch. If there is no longer any need for a line-switching transfer, then a change back

15   to a packet-switching transfer takes place.

In one embodiment of the method according to the present invention, the data packets remain, after the change-over to a line-switching data transfer, as data packets and are then transferred as such by line-switching. In an alternative

20   embodiment, the data packets are unpacketed, more particularly the headers of the data packets are removed, and only the data are then transferred by line-switching. The advantage of the first embodiment lies in the fact that if the data is once again to be transferred over the packet-switching network, they already

25   exist as data packets and therefore time is saved when switching. The advantage of the second embodiment is that by removing the headers from the individual data packets, the effective bandwidth of the data transfer is increased.

In a preferred embodiment of the method according to the

30   present invention, the same data channel is used for transferring the data packets from the first switch to the access point to the packet-switching network, and for transferring data from a first switch to the second switch through the line-switching network. This embodiment has the advantage that only one data channel is

35   constantly engaged which, depending on the type of transfer,

transfers data either to the access point to the packet-switching network, or to the other switch. More particularly in the case of an ISDN network, the same B data channel is used for both sending data to the access point to the packet-switching network, and for sending data through a bypass to another switch.

A data transfer from the first switch to the access point to the packet-switching network always takes place by line-switching. Thus compared with a packet-switching transfer to the access point (e.g., through an ISDN D channel), which is also possible, a larger and fixed bandwidth is ensured up to the access point. If an ISDN network exists, then an ISDN B channel is used as the data channel. Data packets are thereby sent through the B channel by applying them to the ISDN framework. This is known per se and fixed in the PPP protocol.

In a further embodiment, two data channels are provided for data transfer from a first switch, whereby through the first data channel the data packets are transferred to the access point to the packet-switching network, and through the second data channel the data are transferred to the second switch through line-switching. Depending on the type of transfer, either the one data channel or the other data channel is used. This has the advantage that data can be transferred simultaneously by packet-switching and line-switching. By way of example, less important data such as correspondence is transferred by packet-switching and audio data is transferred by line-switching.

In a further preferred embodiment of the present invention, with a line-switching data transfer between the first switch and the second switch or between the first switch and the access point to the packet-switching network, the data of several users are multiplexed on a data channel by forming sub-channels of fixed bandwidth. It is thereby provided that the data of one user are transferred after its selection by line-switching with a transfer rate which corresponds to only a fraction of the

transfer rate of the bandwidth which is available as standard to the user.

More particularly with an ISDN network on the B channels sub channels of a bandwidth of 32, 16, 8, 4, 2 or 1 kbit/s are available. To implement the sub-channels, only each n-th byte or each n-th bit of an ISDN frame is copied over immediately and forwarded on the data channel to the next switch or to the computer network access point.

The formation of sub-channels on a data channel, possibly an ISDN B channel or a data channel of the GSM mobile phone system, allows additional flexibility for the data transfer. In many cases, it is entirely adequate that the bandwidth only uses up a part of the bandwidth which is available on a data channel. The use of the sub-channel thereby has an advantage for the user that according to the bandwidth of the sub-channel, lower costs are incurred but a fixed bandwidth is still available. Sub-channels of different bandwidth thereby define different service quality.

Thus a packet-switching transfer, a line-switching transfer with a part of the available bandwidth of a data channel, and a line-switching transfer with the complete bandwidth of the data channel are available as alternatives.

In a further development of the method according to the present invention, with a change from a packet-switching transfer to a line-switching transfer, the address information of the data packets are evaluated and sorted according to network topology. Thus for each data packet whose destination addresses relate to the same topological area of the network, a switch located in this area is selected, a line-switching connection (bypass) is established to the selected switch and the corresponding data or data packets are transferred to the switch by line-switching.

A classification of the data packets is thereby preferably carried out according to geographical points of view, whereby,

for data packets whose destination address relate to the same geographical area, a switch located in this geographical area is selected and a line-switching connection is established to this switch. This allows a bypass to be effectively established since for data packets with roughly the same destination, a line-switching connection is established directly to a network junction which lies, regarding network topology, in the destination area of the data packets. The establishment of an effective bypass between the individual switches has great importance in the case of packet-switching networks since a data packet can run on the way from Berlin to Munich via Paris and New York. By bringing together all data packets intended for Munich and transferring these data packets by line-switching directly from Berlin to Munich, it is possible to provide a more effective data transfer.

For classifying data packets according to geographical points of view, it is preferable to compare the destination address with destination addresses stored in a data bank whereby the data bank contains a link between the destination addresses and the associated geographical position. The data bank is thereby preferably integrated in the switch. If the data packets are IP data packets, then the relevant IP addresses are consulted in the data bank and assigned to a certain bypass depending on the geographical destination.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows diagrammatically a telecommunications network according to the invention;

FIG. 2 shows diagrammatically a telecommunications network known in the prior art;

FIG. 3 is a diagrammatic illustration of a telecommunications network in which switches according to the invention form an Intranet;

FIG. 4 shows diagrammatically a switch according to the invention;

5   FIG. 5a shows a flow chart of the method according to the invention for transferring data between two switches; and

FIG. 5b shows diagrammatically a flow chart for the method according to the invention for selecting a destination switch through topological points of view.

10

DETAILED DESCRIPTION OF THE DRAWINGS

FIG. 2 shows a conventional telecommunications network. Data terminals such as telephone 1 or personal computer 2 are connected to an exchange 4 of the telephone network directly or

15   by means of a telecommunications apparatus (TK-apparatus) 3 through an ISDN/POTS line. Where applicable, a local network LAN 5 is connected to the TK-apparatus 3. The exchanges 4 pass on incoming connection requests and provide line-switching connections. Entry to a packet-switching network is possible

20   through an access point POP (Point of Presence) 6. Data are transferred between interlinked packet switches 10 by packet-switching through the packet-switching network.

The internet will now be considered as packet-switching network without restricting the present invention. Indeed any

25   packet-switching network could be used such as mobile phone networks within the scope of the present invention.

The technologies used are known per se. The data transfer between terminals 1 and 2 and a line-switch (TK apparatus 3 or the exchange 4) takes place line-oriented, and similarly the data

30   transfer between the individual line switches (such as between the individual exchanges 4 and the POP 6 of the Internet Service Providers IPS). The lines are switched through via coupling fields which are produced in the exchange and in the TK-apparatus.

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The PCM 30 System is particularly wide spread in ISDN
networks wherein 8 Bit codewords for each 30 useful channels
5   within a scanning period of 125 µs are multiplexed and sent in
one pulse frame. However, no multiplexing takes place on a
single channel. The pulse frame is transferred in constant
repetition between sender and receiver even if no useful signals
are contained. In the digital coupling field, individual bytes
10   are copied and then sent (switch of 1-byte-packet). Since during
the exchange process only one byte is read into a memory each
time and then read out again, only a minimal time delay occurs
when exchanging the connecting path.

From the access point POP 6 to the Internet, the transfer
15   of data is still only carried out packet-switched on the basis
of the known network protocol UDP/IP or TCP/IP. Access to the
Internet is brought about by a packet switch (hereinafter also
called IP Switch) which receives data packets which are not
intended for itself and passes them on to the party network whose
20   address they support. During routing, copying of the IP packets
is carried out (switch of multi-byte packets). Time delays
thereby occur in the packet-switching network according to the
size of the IP packet and the number of routers passing on an IP-
packet. These time delays can assume such proportions in the
25   event of overloading the IP switches 10 that in the case of the
Internet telephony, delays of more than 0.5 s may occur.

FIG. 1 shows a telecommunications network according to the
present invention with switches 7a and 7b according to the
present invention which are shown as starred and are described
30   in detail in FIG. 3 .   The switches 7a and 7b integrate the
functions of a packet switch and a line switch.

The important factor is therefore the possibility of
dynamically switching between packet-switching and line-switching
during one transfer, as will be described in further detail
35   below. It is thereby possible to change over, when desired, from

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an asynchronous packet-switching transfer of variable bandwidth
to a synchronous line-switching transfer of greater and fixed
5   bandwidth.   Internet telephony and downloading of files from a
WWW server are two important uses.

The implementation of the switches 7a and 7b takes place
selectively through hardware or software. The line switching, is
thereby preferably implemented by hardware and the packet-
10   switching by software. Thus with line switching, after switching
through a connection the data are forwarded without further
examination, whilst with packet switching the destination
addresses of each data packet is evaluated and the next IP switch
has to be selected from the routing tables. A switching device
15   for the switches 7a and 7b which undertakes a change over between
packet and line-switching is preferably likewise implemented as
software.

The switches 7a and 7b can be mounted according to FIG. 1
at different points in the telecommunications network. The switch
20   7a represents a service access module for connecting the LANs or
end terminals 1 and 2 to the ISDN/PSTN network and internet. On
the user side, the switch 7a has an ethernet interface for a LAN
connection, a printer interface and interfaces for connecting
telephones (radio telephones, ISDN telephones, analog telephones)
25   - not shown. The switch 7a is connected to an exchange point 4
of the telephone network through a line 8.

Since the switch 7a is not a part of the internet, it is
necessary for the packet-switching transfer of data through the
internet to first make a connection with the access point POP 6.
30   This can be carried out through the exchange point 4 or even
through a standing line 9 to the POP 6. The data are transferred
line-switched up to the POP 6 and are preferably already
packeted. If a change to line-switching data transfer is to take
place, then a line to another switch is switched through the
35   exchange 4 and the data are transferred to this by line-

switching. The switch 7a thus routes the IP switched/line-switched channels to the line 8 controlled by same so that they

5   are more cost-effective or more real time depending on the wishes of the user or provider of the channels.

The switch 7a is integrated in the internet and connected to further IP switches 11 and/or line switches 12. Ideally the network still only consists of switches 7b which allow both line

10   switching and packet switching, so that with each switch 7b there is the possibility where necessary of providing a higher quality line-switching transfer instead of a packet-switching transfer. A line-switched transfer is thereby established as bypass, more particularly between switches where a data blockage builds up.

15   FIG. 3 shows a telecommunications network wherein switches 7 which allow a data transfer selectively by packet switching or by line switching form an Intranet within the internet. A real time communications possibility is thereby present between the switches 7. So that this is always possible, additional real time

20   communications channels exist between the switches 7. These are additional ISDN/PSTN connections or additional Intranet channels. A line switching connection (bypass) between the switches 7 can thus arise not only through the telephone network, but also through separate channels.

25   FIG. 4 shows diagrammatically the establishment of a switch 7 according to the present invention. The switch 7 is part of both a packet-switching network (internet) and a line-switching network (telephone network), i.e., it is connected through lines to further network junctions to which it can transfer or receive

30   line-switched or packet-switched data.

Data coming in through a data input 74 can have any source, more particularly come from an IP switch/router, a line-switch such as an exchange point or a telecommunications unit, from a LAN or from an end terminal 1 or 2. The data input 74 has for

35   this purpose, in a known way, an ethernet interface, an analog

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interface with A/D converter and an ISDN interface. In addition
where applicable, an ATM interface and an interface with a mobile
5   phone network can also be provided. The ISDN networks are with
incoming data of 8 bit long words which arrive on a multiplexed
supply line of the switch 7.

The switch 7 has a known IP switch 72 which copies over
incoming IP packets (switch of multi-byte packets) and forwards
10   them in the internet to suitable switches according to the
address of the packets. These relate to the known internet
protocol UDP/IP and TCP/IP. A data compression device 721 is
integrated as an option in the IP switch 72. For data
compression, a reference is made to the international compression
15   standards developed for individual communications, more
particularly the compression process according to ITU standard
G. 72 X. Furthermore, a coding device 722 for coding data packets
can be provided as an option.

Furthermore, the switch 7 has a line switching device 73.
20   This has a digital coupling 731 which is known per se for
switching through telephone conversation channels of the line-
switching network, and a multiplex/demultiplex device 732 which
produces sub-channels on existing data channels, as will be
described in further detail below.

25   The internal control commands, as to whether a packet
switching is to take place through the IP switch or a line
switching is to take place through the line switching device 73,
are produced in a control device 71. The device 71 is
substantially a switch which forwards the incoming data either
30   as data packets to the IP switch 72 or as bit flow to the line
switching device 73. To this end, the control information of the
incoming data are evaluated. The change-over control unit 711
monitors and controls which open connections are present (i.e.,
which and how many data channels are connected) and which
35   bandwidth the individual data channels require.

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In detail the control device 71 has a change-over control unit 711, two packeting/unpacketing devices 713 and 714, and an intermediate register 712. The change-over control unit is connected to a topography data bank 75 which contains geographical data for a number of IP addresses.

If the incoming data are IP packets, then the headers of the IP packets are evaluated by the change-over control unit 711. If the incoming data are a continuous data stream, then the signaling information of the signaling channel (in band signaling or outband signaling) are evaluated by the change-over control unit 711. The basic state thereby provides that the incoming data are sent into the internet through the IP switch 72. If the incoming data do not yet exist as IP packets then they are packeted into corresponding IP packets in the packeting/unpacketing device 714 and sent to the IP switch.

If the data exist as IP packets but are to be transferred line-switched through the line-switching device 73 then the data are, where applicable, unpacketed in the packeting/unpacketing device 713. More particularly the headers, of the data packets are removed. Unpacketing is optional however and not absolutely necessary since data packets can be transferred line-switched where applicable according to the PPP protocol. The (packeted or non-packeted) data are transferred as bit stream to the line switching device 73 by the change-over control unit 711.

Through a control command which is sent by an end terminal or another switch and for example triggered by a user by pressing a certain button on the terminal or by the network management system, the type of communication is switched over to line-oriented or packet-oriented communication.

A corresponding signaling command for changing between packet and line switching is, for example, represented by a certain bit sequence wherein the switching unit 71 stores the detailed incoming data in an intermediate register 712 and

compares it with stored bit sequences. If a certain bit sequence exists, then a change over to a different type of switching is

5   carried out. Alteratively, it can also be possible for the change-over control device 711 to monitor the bandwidth of a transfer and on understepping or exceeding a certain bandwidth and/or in the event of a time delay when forwarding IP data packets to automatically release a control command to change over

10   to the relevant other type of transfer.

To change from packet switching to line switching, first at the command of the control unit 71, a connection is made via the line-switching unit 73 (bypass) with another switch (destination switch). To this end, the ISDN signaling command SETUP is sent

15   to the next exchange point. After the connection is established, all the incoming data of the communications connection considered are no longer directed through the IP-switch 72 but through the line-switching unit 73. The data are now transferred by line-switching with fixed bandwidth through the established bypass to

20   the other switch.

The change-over control unit 711 thereby checks, within the scope of the change-over process and prior to sending the data to the device 73, whether they are IP packets and whether unpacketing is to take place in the packeting/unpacketing device

25   713. The decision on this is made dependent on control signals of the network management system or the end terminal or alternatively by the change-over control unit 711 itself dependent on the data arrival. The control signals here contain corresponding transfer parameters. In each case, the data after

30   being sent to the device 73 are then exposed in the coupling field 731 to an ISDN data frame.

To establish the most effective line-switching connection possible, it is important to select a suitable destination switch where the bypass is established. To this end, a switch is

35   selected as destination switch which lies in a geographical area

which coincides with the destination address of numerous IP packets. Then in particular, these IP packets are transferred through the bypass to the corresponding destination switch so that the data packets still only have a short transfer path from the destination switch to the final destination.

The classification of the IP packets and selection of a corresponding destination switch takes place by means of the topology data bank 75 which contains a geographical link between a number of IP addresses and their geographical position. In the line switching device 73, the IP destination address of each packet is compared with the addresses stored in the data bank 75 and in the event of a successful association of the IP address, this is given a code. This can be a number which characterizes a certain geographical region. This code is recognized by the coupling field 731 and the data packet is then switched through to the corresponding destination switch.

Since it would result in too much time delay to interrogate the data bank 75 for each data packet, the change-over control unit 711 contains a cache which can be quickly accessed and in which the result of the last data bank inquiry is stored. If the IP address of a data packet arriving through the data input 74 is stored in the cache, then the corresponding code can be quickly given.

If the IP address is not contained in the cache, then a data bank inquiry is carried out, and the IP packets are directed onto the IP switch 72 until the result of the data bank inquiry is provided. Only then is a change-over made for this data to a line-switching transfer through a bypass. It is thereby possible that several bypasses to different destination switches exist at the same time whereby the change over control unit 711 controls the coupling field 731 so that the data packets are each time sent to the destination switch which is most favorable from the network topological point of view. The change-over control unit

711 thus informs the coupling field 731 of which data is to be
sent to which destination switch.

5   If the destination address of a data packet is not contained
in the data bank 75, then those intermediate junctions of the
packet-switching network are checked to be fully functioning
which are normally run through when sending data packets with a
certain destination address. To this end, the corresponding data

10   are exchanged between the individual network junctions in known
way by trace routing. At the appropriate intermediate junctions,
i.e., the intermediate junctions with low functioning output, it
is determined whether the ISDN number is known and this is
requested where applicable. The change-over control unit 711 of

15   the data bank 75 is thereby operated in the manner already
described. A bypass is then established from the change-over
control unit 711 to a switch which lies in the chain of switches
as close as possible to the destination switch.

          The multiplex/demultiplex device 732 of the line-switching

20   device 73 allows, depending on the control commands of the
change-over control unit 711, a line-switching transfer to sub-
channels with a bandwidth which corresponds to a fraction of the
usual bandwidth of a data channel considered. Data channels are
thereby bundled which are formed or determined in the coupling

25   field 731 according to the control commands of the change-over
control unit 711. A time multiplex channel of the PCM 30 system
is considered as ISDN data frame which has information of 30 data
channels and two signal channels. The bandwidth of the data
channels each amounts to 64 kbit/s.

30   The multiplex/demultiplex device 732 allows a multiplexing
inside each of the 30 data channels of the time multiplex
channel. To this end, two methods are alternatively used. In a
first method only a part of the 8 bit of a PCM Word is switched
through each other, thus 1, 2 or 4 bits. The bandwidth is

35

reduced accordingly to 8, 16 or 32 kbit/s. The data of several
channels are in this way multiplexed on one data channel.

5   Alternatively a PCM word (byte) of the time multiplex
channel of the PCM 30 system is not switched through in each of
the successive pulse frames, but only in each n-th pulse frame
whereby the bandwidth is reduced to 64/n kbit/s.

The two multiplex methods described can also be combined.
10 By way of example, one bandwidth of 1 kbit/s is produced for one
data channel in that each eight bit in each eighth frame of the
ongoing data channel stems from the data channel considered.

The switching through in the line switching device 731 takes
place, depending on the selected data rate, and in the case of
15 transfer rates per data channel unequal to 64 kbit/s, includes
the multiplex/demultiplex device 732. If no multiplexing takes
place on a data channel, then the data are passed by the
multiplex/demultiplex device 732.

For the channel or sub-channel considered, a line-switching
20 transfer takes place to the switch which represents the other
side of the line-switching connection until a control command
again reaches the device 71 to switch over again to packet-
switching. This command is in turn coded by a certain bit
sequence or is produced automatically. Then through the control
25 device, the switched-through line is broken off and the incoming
data are then again directed to the IP switch 72.

FIGs. 5a and 5b show the method sequence. FIG. 5a shows the
course of the method when changing from a packet-switching data
transfer to a line-switching data transfer between two switches.
30 With the presence of a corresponding control signal, a line-
switching connection is set up to another switch and the data
sent by line-switching.

If a line-switching data transfer is to take place to sub-
channels of fixed bandwidth then a multiplexer/demultiplexer is
35 activated which multiplexes several data streams so that each

time only every n^{th} bit and/or every n^{th} byte is reserved in the
outgoing data stream for an incoming data stream. It can thereby
5   be provided that the individual sub-channels have a different
bandwidth, i.e., the different input data streams have different
proportions in the outgoing data stream. With the presence of
a further control signal, a change back to a packet-switching
transfer is undertaken.

10   FIG. 5b shows the selection of a suitable switch when
establishing a bypass. To this end, the headers of the IP data
packets are compared with the information of a data bank. If the
header information is associated with a certain geographical
destination, then the bypass is established to a switch mounted
15   in this geographical area. If the header information is not
associated with a certain geographical destination, then as
described above, a bypass is made to an intermediate junction
where the data packets pass through in the normal case. Where
applicable, the switch has numerous bypasses to different
20   switches wherein each time only data packets with the same or
similar topological destination features are transferred to the
individual switches within the frame of the bypass.

The present invention is not restricted in its design to the
embodiments given above. Rather a number of variations are
25   possible which make use of the invention even in fundamentally
different types of designs.

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ABSTRACT

     A method for transferring data from a first switch to a
5   second switch selectively by line-switching or by packet-
switching as well as to a switch for carrying out the method.
Data packets are thereby first transferred packet-switched
through a packet-switching network to the second switch. With
the presence of a corresponding control signal a line-switching
10   connection is established from the first switch to the second
switch and the data are then transferred through this connection.

     Where applicable a renewed change over to a packet-switching
transfer is carried out. A flexible packet-switching or line-
switching data transfer linked with dynamic costs between the
15   junctions of a telecommunications network is enabled.

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METHOD FOR TRANSFERRING DATA IN A TELECOMMUNICATIONS
NETWORK AND SWITCH FOR THE IMPLEMENTATION OF THE METHOD

5 Subject of the invention

The invention relates to a method for transferring data from
a first switch to a second switch selectively by line
switching or by packet switching and to a switch for
10 carrying out the method.

Background of the invention

The present-day situation in telecommunications is marked by
15 a division between two different connecting and switching
technologies. These are the synchronous line-switching
technology (line-switching or circuit switching) and
asynchronous packet-switching technology (packet-switching).

20 Line-switching connections use line switches alias line
switching equipment between the individual line sections
which each copy over 1 byte packets and have a corresponding
buffer size. Packet-switching connections use packet
switches alias packet switching equipment between the
25 individual line sections of a network which copy over multi-
byte packets. The buffer size of the packet switch
correspondingly amounts to n bytes wherein n stands for the
number of bytes of the copied data packets. The term
"switch" is used below so that it includes both a line
30 switch of a line switching network and a packet switch of a
packet switching network.

A line switch alias line switching equipment is called
telecommunications apparatus (TK apparatus) in the private
35 sector and exchanges of the network supplies in the public

sector. A packet switch alias packet switching apparatus is also called a router, IP switch or host computer.

Line switching connections are synchronous, ie data
5   transfer is carried out substantially without any time delay from one line section to an adjoining line section through a switch (here line switching apparatus).

When a line-switching call is put through, a connection is
10   continually provided in real time with the complete band width of a channel between two points. Even if no useful news is being sent eg during a telephone conversation the transmission channel is occupied or engaged.   Line-switching connections are expensive, particularly when
15   thinking of telephone conversations since the costs arise irrespectively of the information actually transferred. The advantage lies in a connection which is free of any time delay and which has a fixed band width.

20   The other important type of data exchange nowadays is the packet exchange. With packet exchange data, eg audio data, video data or computer files are packeted and transferred as data packets. Packet switching works on the asynchronous transfer mode, ie data is transferred time-delayed between
25   two adjoining line sections by a switch (here packet switching apparatus). In the case of packet-switching exchanges, and quite different from line-switching exchanges, a fixed connection does not have to be maintained. It is connection-less, ie each packet is
30   treated individually and not in conjunction with others.

Packet switching is used in particular on the Internet. The data packets are termed there as IP packets (IP = Internet Protocol). Each IP packet contains a header which contains
35   inter alia a sender and receiver address. The IP packets

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form a data flow which is transferred through packet
switching apparatus (alias IP switches alias Routers alias
Host computers) in the Internet from the sender to the
relevant receiver.

5

As a result of the length of the IP packets (from 16 bytes
upwards) a time delay occurs in the packet switching
apparatus when copying. This time delay can be so great
when there is a heavy load on the packet switching apparatus
10   which pass a data packet over the route to the destination
address that certain applications are no longer possible.

These delays are of considerable significance particularly
in the case of the Internet. With Internet telephony a
15   cost-conscious caller uses the normal Internet with
approximately 8 kbit/s bandwidth and a time delay of 0.5
seconds. When overloading the Internet the time delay of
the individual packets becomes so long that an acceptable
conversation connection between telephone partners is no
20   longer possible.

Internet telephony is marked by the great advantage that
there are incurred only the relevant local telephone charges
at the next POP (Point of Presence), the access point to the
25   Internet offered by an Internet Service Provider ISP, as
well as time charges calculated by the ISPs for the length
of the Internet access as well as where applicable volume
charges, but not however expensive telephone charges.

30   From US PS 4 996 685 a method and device are known which
allow in an ISDN communications network during an existing
connection between a user and a host computer a dynamic
change between a line switching connection through an ISDN
B channel and a packet-switching connection through an ISDN
35   D channel. A command to change between a line-switching and

a packet-switching connection thereby always emanates from the Host computer.

The method disclosed from US PS 4 996 685 is restricted to undertaking on an ISDN connection a change between a line-switching and a packet-switching data transfer whereby a line-switching transfer is carried out on a B channel and a packet-switching transfer is carried out on the D channel. A method of this kind is indeed expedient to produce effective access from an end subscriber to a host computer, possibly an exchange point of the telephone network or an access point to the internet but does not relate to the transfer of data between switches or routers of a network.

Object of the invention

Based on the prior art the present invention is concerned with the problem of providing a method for transferring data from a first switch to a second switch and providing a switching for carrying out the method which in dependence on the data origin and headers of a user or network management system allows flexible data transfer between the switches and more particularly a cost-effective data transfer with real time properties.

Abstract of the invention

The object of the invention is achieved according to the invention by a method with the features of claim 1, a method with the features of claim 2, and a switch with the features of claim 16. Advantageous embodiments of the invention are characterised in the sub-claims.

The solution according to the invention makes it possible during a packet-switching connection between two switches to

achieve a dynamic change-over to line-switching connection without interrupting the connection. This is always advisable if a data build up of data packets exists before the switches of the packet-switching network. Through the
5 establishment of a line-switching connection between the switches a bypass is produced according to the invention on which data can be transferred with fixed band width and slight time delays substantially with real time so that the data blockage is by-passed. Since a line switching
10 connection is however only established when required, ie when a packet-switching data transfer no longer has the desired band width, the invention allows a flexible most cost-effective data transfer.

15 The term "switch" is used in the sense of the invention as already explained so that it includes both a line-switch of a line-switching network which copies over 1-byte packets, and also a packet-switch (router) of a packet-switching network which copies over multi-byte packets. Data to be
20 transferred can be any type of data, such as audio data, video data or computer files.

The invention provides for carrying out the method according to the invention switches which allow both line-switching
25 and packet-switching and combine the functions of a line-switch and a packet-switch. A switch according to the invention has a packeting device for packeting and unpacketing data, an IP switching device for routing data packets, a line-switching device for establishing
30 connections for switching through data channels and a control device which directs incoming data either to the IP switching device or to the line switching device depending on the control signals.

35 The corresponding control signals are triggered by a user or

at the command of a network management system and are transferred together with other signalling data to the switch. Alternatively the switch itself automatically produces a corresponding control command on exceeding a
5   certain band width of the packet-switching transfer.

The network which consists of interconnected switches according to the invention forms an Intranet wherein data transfer can be interchanged dynamically between line
10   switching and packet switching and which ensures under normal conditions data transfer substantially in real time through the possibility of establishing when required a line-switching connecting of fixed band width. This is particularly important for internet telephony.
15

There are numerous useful areas for the switches according to the invention. The switches according to the invention can even replace conventional line-switches such as TK equipment and exchanges as well as packet switches. More
20   particularly they can be used to build up new networks with real time capacity (intranets) which can operate both by line-switching and by packet-switching.

The method according to the invention is used in a first
25   variation of the invention between two switches which are indeed part of a line-switching network but which are not directly part of a packet-switching network. Therefore for a packet-switching transfer first a connection is established through the line-switching network from a first
30   switch to an access point to the packet-switching network (such as Internet access point). The data are transferred line-switched to the access point to the packet-switched network where they are packeted if they do not already exist as packets, and are transferred from the access point
35   packet-switched through the packet-switching network to the

second switch.   The data are thereby preferably already
packeted in the first switch and transferred as data packets
line-switched to the access point.

5   If both switches are both part of a line-switching network
and a packet-switching network then in a second variation of
the method according to the invention a packet-switched data
transfer can take place directly between the switches.   With
both variations with the presence of a corresponding control
10   signal a line-switching connection is built up through the
line-switching network directly with the second switch.   If
there is no longer any need for a line-switching transfer
then a change back to a packet-switching transfer takes
place.
15
In one embodiment of the method according to the invention
the data packets remain after the change-over to a line-
switching data transfer as data packets and are then
transferred as such by line-switching.   In an alternative
20   embodiment   the   data   packets   are   unpacketed,   more
particularly the headers of the data packets are removed and
the data are only then transferred by line-switching.   The
advantage of the first variation lies in the fact that the
data with renewed transfer to packet-switching network
25   already exist as data packets and therefore time is saved
when switching.   The advantage of the second variation is
that by removing the headers from the individual data
packets the effective band width of the data transfer is
increased.
30
In a preferred embodiment of the method according to the
invention the same data channel is used for transferring the
data packets from the first switch to the access point to
the packet-switching network and for transferring data from
35   a first switch to the second switch through the line-

switching network, This has the advantage that only one data channel is only constantly engaged which depending on the type of transfer transfers data either to the access point to the packet-switching network or to the other

5 switch. More particularly in the case of an ISDN network the same B data channel is used both for sending data to the access point to the packet-switching network and for sending data through a bypass to another switch.

10 A data transfer from the first switch to the access point to the packet-switching network always takes place by line-switching. Thus compared with a packet-switching transfer to the access point (eg through an ISDN D channel) which is also possible a larger and fixed band width is ensured up to

15 the access point. If an ISDN network exists then an ISDN B channel is used as the data channel. Data packets are thereby sent through the B channel by applying them to the ISDN framework. This is known per se and fixed in the protocol PPP.

20

In a further embodiment two data channels are provided for data transfer from a first switch whereby through the first data channel the data packets are transferred to the access point to the packet-switching network and through the second

25 data channel the data are transferred to the second switch through line-switching. Depending on the type of transfer either the one data channel or the other data channel is used. This has the advantage that data can be transferred simultaneously by packet-switching and line-switching. By

30 way of example less important data such as correspondence is transferred by packet-switching and audio data is transferred by line-switching.

In a further preferred embodiment of the invention with a

35 line-switching data transfer between the first switch and

the second switch or between the first switch and the access point to the packet-switching network the data of several users are multiplexed on a data channel by forming sub-channels of fixed band width. It is thereby provided that

5   the data of one user are transferred after its selection by line-switching with a transfer rate which corresponds to only a fraction of the transfer rate of the band width which is available as standard to the user.

10   More particularly with an ISDN network on the B channels sub channels of a band width of 32, 16, 8, 4, 2 or 1 kbit/s are available . To implement the sub-channels only each n-th byte or each n-th bit of an ISDN frame is copied over immediately and forwarded on the data channel to the next

15   switch or to the computer network access point.

The formation of sub-channels on a data channel, possibly an ISDN B channel or a data channel of the GSM mobile phone system, allows additional flexibility for the data transfer.

20   With many cases it is entirely adequate that the band width only uses up a part of the band width which is available on a data channel. The use of the sub-channel thereby has an advantage for the user that according to the band width of the sub-channel lower costs are incurred but a fixed band

25   width is thereby available. Sub-channels of different band width thereby define different service quality.

Thus a packet-switching transfer, a line-switching transfer with a part of the available band width of a data channel

30   and a line-switching transfer with the complete band width of the data channel are available as alternatives.

In a further development of the method according to the invention with a change from a packet-switching transfer to

35   a line-switching transfer the address information of the

data packets are evaluated and sorted according to network
topology.   Thus   for   each   data   packet   whose   destination
addresses relate to the same topological area of the network
a switch located in this area is selected, a line-switching
5   connection (bypass) is established to the selected switch
and the corresponding data or data packets are transferred
to the switch by line-switching.

A classification of the data packets is thereby preferably
10   carried   out   according   to   geographical   points   of   view,
whereby for data packets whose destination address relate to
the   same   geographical   area   a   switch   located   in   this
geographical   area   is   selected   and   a   line-switching
connection is established to this switch.   This allows a
15   bypass to be effectively established since for data packets
with   roughly   the   same   destination   a   line-switching
connection is established directly to a network junction
which lies regarding network topology in the destination
area of the data packets.   The establishment of an effective
20   bypass between the individual switches has great importance
in the case of packet-switching networks since a data packet
can run on the way from Berlin to Munich via Paris and New
York.   By bringing together all data packets intended for
Munich and transferring these data packets by line-switching
25   directly from Berlin to Munich it is possible to provide a
more effective data transfer.

For classifying data packets according to geographical
points of view it is preferred to compare the destination
30   addresses with destination addresses stored in a data bank
whereby   the   data   bank   contains   a   link   between   the
destination   addresses   and   the   associated   geographical
position.   The data bank is thereby preferably integrated in
the switch.   If the data packets are IP data packets then
35   the relevant IP addresses are consulted in the data bank and

assigned to a certain bypass depending on the geographical destination.

Description of an embodiment

5

The invention will now be explained with reference to the embodiments shown in the drawings in which:

Figure 1   shows   diagrammatically   a   telecommunications
10   network according to the invention;
Figure 2   shows   diagrammatically   a   telecommunications
            network known in the prior art;
Figure 3   is   a   diagrammatic   illustration   of   a
            telecommunications   network   in   which   switches
15   according to the invention form an Intranet;
Figure 4   shows diagrammatically a switch according to the
            invention;
Figure 5a   shows a flow chart of the method according to the
            invention for transferring data between two
20   switches and
Figure 5b   shows diagrammatically a flow chart for the method
            according   to   the   invention   for   selecting   a
            destination switch through topological points of
            view.

25

Figure 2 shows a conventional telecommunications network. Data terminals such as telephone 1 or personal computer 2 are connected to an exchange 4 of the telephone network directly or by means of a telecommunications apparatus (TK-
30 apparatus) 3 through an ISDN/POTS line. Where applicable a local network LAN 5 is connected to the TK-apparatus 3. The exchanges 4 pass on incoming connection wishes and provide line-switching connections. Entry to a packet-switching network is possible through an access point POP (Point of
35 Presence) 6.   Data are transferred between interlinked

packet switches 10 by packet-switching through the packet-switching network.

The internet will now be considered as packet-switching
network without restricting the invention. Indeed any
packet-switching networks could be used such as mobile phone
networks within the scope of the invention.

The technologies used are known per se. The data transfer
between terminal 1, 2 and a line-switch (TK apparatus 3 or
the exchange 4) takes place line-orientated, and similarly
the data transfer between the individual line switches (such
as between the individual exchanges 4 and the POP 6 of the
Internet Service Providers IPS). The lines are switched
through via coupling fields which are produced in the
exchange and in the TK-apparatus.

The PCM 30 System is particularly wide spread in ISDN
networks wherein 8 Bit codewords for each 30 useful channels
within a scanning period of 125 μs are multiplexed and sent
in one pulse frame. However no multiplexing takes place on
a single channel. The pulse frame is transferred in
constant repetition between sender and receiver even if no
useful signals are contained. In the digital coupling field
individual bytes are copied and then sent (switch of 1-byte-
packet). Since during the exchange process only one byte is
read into a memory each time and then read out again only a
minimal time delay occurs when exchanging the connecting
path.

From the access point POP 6 to the Internet the transfer of
data is still only carried out packet-switched on the basis
of the known network protocol IP/UDP or IP/TCP. Access to
the Internet is brought about by a packet switch
(hereinafter also called IP Switch) which receives data

packets which are not intended for itself and passes them on to the party network whose address they support. During routing copying of the IP packets is carried out (switch of multi-byte packets) . Time delays thereby occur in the

5   packet-switching network according to the size of the IP packet and the number of routers passing on an IP-packet. These time delays can assume such proportions in the event of overloading the IP switches 10 that in the case of the Internet telephony delays of more than 0.5 s occur.

10

Figure 1 shows a telecommunications network according to the invention with switches 7,7a according to the invention which are shown as starred and are described in detail in Figure 3 . The switches 7a, 7b integrate the functioning of

15   a packet switch and a line switch.

The important factor is thereby the possibility of dynamically switching between packet-switching and line-switching during one transfer, as will be described in

20   further detail below. It is thereby possible to change over from an asynchronous packet-switching transfer of variable band width when desired to a synchronous line-switching transfer of greater and fixed band width. Internet telephony and downloading of files from a WWW server are two

25   important uses.

The implementation of the switches 7a, 7b takes place selectively through hardware or software. The line switching is thereby preferably implemented by hardware and

30   the packet-switching by software. Thus with line switching after switching through a connection the data are forwarded without further examination whilst with packet switching the destination addresses of each data packet is evaluated and the next IP switch has to be selected from the routing

35   tables. A switching device for the switch 7 which

undertakes a change over between packet and line switching is preferably likewise implemented as software.

The switches 7a, 7b can be mounted according to Figure 1 at
5   different points in the telecommunications network. The switch 7a represents a service access module for connecting the LANs or end terminals 1, 2 to the ISDN/PSTN network and internet. On the user side the switch 7a has an ethernet interface for a LAN connection, a printer interface and
10   interfaces for connecting telephones (radio telephones, ISDN telephones, analogue telephones) - not shown. The switch 7a is connected to an exchange point 4 of the telephone network through a line 8.

15   Since the switch 7a is not part of the internet it is necessary for the packet-switching transfer of data through the internet to first make a connection with the access point POP 6. This can be carried out through the exchange point 4 or even through a standing line 9 to the POP 6. The
20   data are transferred line-switched up to the POP 6 and are preferably already packeted. If a change to line-switching data transfer is to take place then a line to another switch is switched through the exchange 4 and the data are transferred to this by line-switching. The switch 7a thus
25   routes the IP switched/line-switched channels to the line 8 controlled by same so that they are more cost-effective or more real time depending on the wishes of the user or provider of the channels.

30   The switch 7a is integrated in the internet and connected to further IP switches 11 and/or line switches 12. Ideally the network still only consists of switches 7b which allow both line switching and packet switching, so that with each switch 7b there is the possibility where necessary of
35   providing a higher quality line-switching transfer instead

of a packet-switching transfer. A line-switched transfer is thereby established as bypass, more particularly between switches where a data blockage builds up.

5   Figure 3 shows a telecommunications network wherein switches 7 which allow a data transfer selectively by packet switching or by line switching form an Intranet within the internet. A real time communications possibility is thereby present between the switches 7. So that this is always

10   possible additional real time communications channels exist between the switches 7. These are additional ISDN /PSTN connections or additional Intranet channels. A line switching connection (bypass) between the switches 7 can thus not only arise through the telephone network but also

15   through separate channels.

Figure 4 shows diagrammatically the establishment of a switch 7 according to the invention. The switch 7 is part of both a packet-switching network (internet) and a line-

20   switching network (telephone network), ie it is connected through lines to further network junctions to which it can transfer or receive line-switched or packet-switched data.

Data coming in through a data input 74 can have any source,

25   more particularly come from an IP switch/router, a line-switch such as an exchange point or a telecommunications unit, from a LAN or from an end terminal 1, 2. The data input 74 has for this purpose in known way an ethernet interface, an analogue interface with A/D converter and an

30   ISDN interface. In addition where applicable an ATM interface and an interface with a mobile phone network can also be provided. The ISDN networks are with incoming data 8 bit long words which arrive on a multiplexed supply line of the switch 7.

35

The switch 7 has a known IP switch 72 which copies over incoming IP packets (switch of multi-byte packets) and forwards them in the internet to suitable switches according to the address of the packets. These relate to the known internet protocol IP/UDP and IP/TCP. A data compression device 721 is integrated as an option in the IP switch 72. For data compression reference is made to the international compressions standards developed for individual communications, more particularly the compression process according to ITU standard G. 72 X. Furthermore a coding device 722 for coding data packets can be provided as an option.

Furthermore the switch 7 has a line switching device 73. This has a digital coupling 731 which is known per se for switching through telephone conversation channels of the line-switching network and a multiplex/demultiplex device 732 which produces sub-channels on existing data channels, as will be described in further detail below.

The internal control commands, as to whether a packet switching is to take place through the IP switch or a line switching is to take place through the line switching device 73, are produced in a control device 71. The device 71 is substantially a switch which forwards the incoming data either as data packets to the IP switch 72 or as bit flow to the line switching device 73. To this end the control information of the incoming data are evaluated. The change-over control unit 711 monitors and controls which open connections are present (ie which and how many data channels are connected) and which band width the individual data channels require.

In detail the control device 71 has a change-over control unit 711, two packeting/unpacketing devices 713, 714 and an

intermediate register 712. The change-over control unit is connected to a topography data bank 75 which contains geographical data for a number of IP addresses.

5   If the incoming data are IP packets then the header of the IP packets is evaluated by the change-over control unit 711. If the incoming data are a continuous data stream then the signalling information of the signalling channel (in band signalling or outband signalling) are evaluated by the

10   change-over control unit 711. The basic state thereby provides that the incoming data are sent into the internet through the IP switch 72. If the incoming data do not yet exist as IP packets then they are packeted into corresponding IP packets in the packeting/unpacketing device

15   714 and sent to the IP switch.

If the data exist as IP packets but are to be transferred line-switched through the line-switching device 73 then the data are where applicable unpacketed in the

20   packeting/unpacketing device 713. More particularly the header of the data packets is removed. Unpacketing is however optional and not absolutely necessary since data packets can be transferred line-switched where applicable according to the protocol PPP. The (packeted or non-

25   packeted) data are transferred as bit stream to the line switching device 73 by the change-over control unit 711.

Through a control command which is sent by an end terminal or another switch and for example triggered by a user by

30   pressing a certain button on the terminal or by the network management system, the type of communication is switched over to line-orientated or packet-orientated communication.

A corresponding signalling command for changing between

35   packet and line switching is for example represented by a

certain bit sequence wherein the switching unit 71 stores the detailed incoming data in an intermediate register 712 and compares it with stored bit sequences. If a certain bit sequence exists then a change over to a different type of

5 switching is carried out. Alteratively it can also be possible for the change-over control device 711 to monitor the band width of a transfer and on understepping or exceeding a certain band width and/or in the event of a time delay when forwarding IP data packets to automatically

10 release a control command to change over to the relevant other type of transfer.

To change from packet switching to line switching first at the command of the control unit 71 a connection is made via

15 the line-switching unit 73 (bypass) with another switch (destination switch). To this end the ISDN signalling command SETUP is sent to the next exchange point. After the connection is established all the incoming data of the communications connection considered are no longer directed

20 through the IP-switch 72 but through the line-switching unit 73. The data are now transferred by line-switching with fixed band width through the established bypass to the other switch.

25 The change-over control unit 711 thereby checks within the scope of the change-over process and prior to sending the data to the device 73 whether they are IP packets and whether unpacketing is to take place in the packeting/unpacketing device 713. The decision on this is

30 made in dependence on control signals of the network management system or the end terminal or alternatively by the change-over control unit 711 itself in dependence on the data arrival. The control signals here contain corresponding transfer parameters. In each case the data

35 after being sent to the device 73 are then exposed in the

coupling field 731 to an ISDN data frame.

To establish the most effective line-switching connection possible it is important to select a suitable destination switch where the bypass is established.   To this end a switch is selected as destination switch which lies in a geographical area which coincides with the destination address of numerous IP packets.   Then in particular these IP packets   are   transferred   through   the   bypass   to   the corresponding destination switch so that the data packets still only have a short transfer path from the destination switch to the final destination.

The classification of the IP packets and selection of a corresponding destination switch takes place by means of the topology data bank 75 which contains a geographical link between a number of IP addresses and their geographical position.   In the line switching device 73 the IP destination address of each packet is compared with the addresses stored in the data bank 75 and in the event of a successful association of the IP address this is given a code.   This can be a number which characterises a certain geographical region.   This code is recognized by the coupling field 731 and the data packet is then switched through to the corresponding destination switch.

Since it would result in too much time delay to interrogate the data bank 75 for each data packet the   change-over control unit 711 contains a cache which can be quickly accessed and in which the result of the last data bank enquiry is stored.   If the IP address of a data packet arriving through the data input 74 is stored in the cache then the corresponding code can be quickly given.

If the IP address is not contained in the cache then a data

bank enquiry is carried out and the IP packets are directed onto the IP switch 72 until the result of the data bank enquiry is provided. Only then is a change over made for this data to a line-switching transfer through a bypass. It

5   is thereby possible that several bypasses to different destination switches exist at the same time whereby the change over control unit 711 controls the coupling field 731 so that the data packets are each time sent to the destination switch which is most favourable from the network

10   topological point of view. The change-over control unit 711 thus informs the coupling field 731 of which data is to be sent to which destination switch.

If the destination address of a data packet is not contained

15   in the data bank 75 then those intermediate junctions of the packet-switching network are checked to be fully functioning which are normally run through when sending data packets with a certain destination address. To this end the corresponding data are exchanged between the individual

20   network junctions in known way by trace routing. At the appropriate intermediate junctions, ie the intermediate junctions with low functioning output, it is determined whether the ISDN number is known and this is requested where applicable. The change-over control unit 711 of the data

25   bank 75 is thereby operated in the manner already described. A bypass is then established from the change-over control unit 711 to a switch which lies in the chain of switches as close as possible to the destination switch.

30   The multiplex/demultiplex device 732 of the line-switching device 73 allows in dependence on the control commands of the change-over control unit 711 a line-switching transfer to sub-channels with a band width which corresponds to a fraction of the usual band width of a data channel

35   considered. Data channels are thereby bundled which are

formed or determined in the coupling field 731 according to the control commands of the change-over control unit 711. A time multiplex channel of the PCM 30 system is considered as ISDN data frame which has information of 30 data channels
5   and two signal channels.   The band width of the data channels each amounts to 64 kbit/s.

The multiplex/demultiplex device 732 allows a multiplexing inside each of the 30 data channels of the time multiplex
10   channel.   To this end two methods are alternatively used. In a first method only a part of the 8 bit of a PCM word is switched through each other, thus 1, 2 or 4 bit.   The band width is reduced accordingly to 8, 16 or 32 kbit/s.   The data of several channels are in this way multiplexed on one
15   data channel.

Alternatively a PCM word (byte) of the time multiplex channel of the PCM 30 system is not switched through in each of the successive pulse frames, but only in each n-th pulse
20   frame whereby the band width is reduced to 64 kbit/s /n.

The two multiplex methods described can also be combined. By way of example one band width of 1 kbit/s is produced for one data channel in that each eight bit in each eighth frame
25   of the ongoing data channel stems from the data channel considered.

The switching through in the line switching device 731 takes place in dependence on the selected data rate and in the
30   case of transfer rates per data channel unequal to 64 kbit/s includes the multiplex/demultiplex device 732.   If no multiplexing takes place on a data channel then the data are passed by the multiplex/demultiplex device 732.

35   For the channel or sub-channel considered, a line-switching

transfer takes place to the switch which represents the other side of the line-switching connection until a control command again reaches the device 71 to switch over again to packet-switching. This command is in turn coded by a
5 certain bit sequence or is produced automatically. Then through the control device the switched-through line is broken off and the incoming data are then again directed to the IP switch 72.

10 Figures 5a and 5b show the method sequence. Figure 5a shows the course of the method when changing from a packet-switching data transfer to a line-switching data transfer between two switches. With the presence of a corresponding control signal a line-switching connection is set up to
15 another switch and the data sent by line-switching.

If a line-switching data transfer is to take place to sub-channels of fixed band width then a multiplexer/ demultiplexer is activated which multiplexes several data
20 streams so that each time only each nth bit and/or each nth byte is reserved in the outgoing data stream for an incoming data stream. It can thereby be provided that the individual sub-channels have a different band width, ie the different input data streams have different proportions at the
25 outgoing data stream. With the presence of a further control signal a change back to a packet-switching transfer is undertaken.

Figure 5b shows the selection of a suitable switch when
30 establishing a bypass. To this end the headers of the IP data packets are compared with the information of a data bank. If the header information is associated with a certain geographical destination then the bypass is established to a switch mounted in this geographical area.
35 If the header information is not associated with a certain

geographical destination then as described above a bypass is made to an intermediate junction where the data packets pass through in the normal case. Where applicable the switch has numerous bypasses to different switches wherein each time only data packets with the same or similar topological destination features are transferred to the individual switches within the frame of the bypass.

The invention is not restricted in its design to the embodiments given above. Rather a number of variations are possible which make use of the invention even in fundamentally different types of designs.

CLAIMS:

1.   Method for transferring data from a first switch to a
second switch which are part of a line-switching network or
have access to a line-switching network, selectively by
line-switching or packet-switching, consisting of the
following steps:
     a)   establishing a connection through the line-
switching network from a first switch to an access point of
a packet-switching network;
     b) line-switching transfer of data from the first
switch to the access point of the packet-switching network;
     c) packeting of the data if this does not yet exist as
data packets, and packet-switching transfer of the data
packets through the packet-switching network from access
point to the second switch;
     d) repeated checks whether a control signal exists for
establishing a line-switching connection with the second
switch;
     e) establishing a line-switching connection from first
switch to second switch through the line-switching network
with the presence of a corresponding control signal;
     f) changing to a line-switching data transfer and
transferring data to the second switch.

2.   Method for transferring data from a first switch to a
second switch which are both part of a line-switching
network and a packet-switching network and have access to
such network, selectively through line-switching or through
packet-switching, consisting of the followings steps:
     a) packeting the data in the first switch if the data
does not yet exist as data packets;
     b) packet-switching transfer of data packets through
the packet-switching network to the second switch;
     c) repeated checking whether a control signal exists

for establishing a line-switching connection with the second switch;

     d) establishing a line-switching connection through the line-switching network to the second switch with the presence of a corresponding control signal;

     f) change to a line-switching data transfer and transferring data to the second switch.

3. Method according to claim 1 or 2 wherein the data packets after changing to a line-switching data transfer remain as data packets and are transferred as such by line-switching.

4. Method according to claim 1 or 2 wherein the data packets after changing to a line-switching data transfer are unpacketed, more particularly the headers of the data packets are removed.

5. Method according to at least one of claims 1 , 3 or 4 wherein the same data channel is used to send the data packets to the access point to the packet-switching network and to transfer the data through the line-switching network to the second switch.

6. Method according to at least one of claims 1, 3 or 4 wherein the data packets are transferred to the access point to the packet-switching network through a first data channel and the data are transferred for line-switching to the second switch through a second data channel.

7. Method according to at least one of the preceding claims wherein the line-switching network represents an ISDN network with ISDN switches, the data packets have the format TCP/IP and the data channels used for line-switching data transfer represent ISDN B channels.

8. Method according to at lest one of the preceding claims wherein the control signal which releases a change between the line-switching and packet-switching transfer on

5 understepping or exceeding certain demands on the quality of the data transfer such as time delay or noise proportion, is produced automatically or as a result of a command of a network management system or an end appliance.

10 9. Method according to at least one of the preceding claims wherein with a line-switching data transfer between the first switch and the second switch or between the first switch and the access point to the packet-switching network the data of several users are multiplexed on one data

15 channel by forming sub-channels of fixed band width.

10. Method according to claim 9 wherein the data of one user after its selection are transferred line-switched with a transfer rate which corresponds to a fraction of the

20 transfer rate of the band width which is available as standard to the user.

11. Method according to claim 9 or 10 wherein the line-switched network is as ISDN network and the data of one user

25 to be transferred are transferred between the switches or one switch and the access point to the packet-switching network on one data channel with a band width which corresponds to a fraction of the band width of 64 kbit/s which is available as standard, more particularly 32, 16, 8,

30 4, 2 or 1 kbit/s.

12. Method according to claim 11 wherein in the switch only each nth byte or each nth bit of an ISDN frame is copied over and forwarded on the switched-through data channel to the

35 next switch or to an access point to the packet-switching

network whereby the band width of the transfer is 64 kbit/s /n.

13.   Method according to at least one of the preceding claims wherein with a change over from a packet-switching transfer to a line-switching transfer

    a) the address information of the data packets are evaluated and classified according to network topology;

    b) for the data packets whose destination addresses relate to the same topological area of the network a switch is selected which is located in this area;

    c) a line-switching connection (bypass) is established with the selected switch and

    d) the corresponding data or data packets are transferred line-switched to the switch.

14.   Method according to claim 13 characterised in that to classify the data packets according to network topology the destination addresses of the data packets are sorted according to geographical areas whereby for data packets whose destination addresses relate to the same geographical area a switch is selected which is located in this geographical area and a line-switching connection is established with this switch.

15.   Method according to claim 14 characterised in that for classifying the data packets according to geography the destination addresses are compared with destination addresses stored in a data bank whereby the data band contains a link between the destination addresses and the associated geographic situation.

16.   Switch for use in a method according to claims 1 or 2 with

    a) at least one packeting device (713, 714) for

packeting and unpacketing data;

b) an IP switching device (72) for routing data packets;

c) a line switching device (73) for establishing connections and switching through data channels;

d) a control device (71) which directs incoming data either to the IP switching device (72) or to the line switching device (73) in dependence on control signals.

17.   Switch according to claim 16 which has furthermore a topology data bank (75) which contains associations between destination addresses of data packets and associated geographical origin.

18.   Switch according to claim 16 or 17 which contains furthermore a multiplexer (732) which with the presence of a corresponding control command multiplexes several data streams so that only each n-th bit and/or each n-th byte is used in the outgoing data channel.

19.   Switch according to claim 18 wherein different input data streams occupy different sized proportions in the outgoing data channel.

20.   Switch according to one of claims 16 to 19 which has in addition a device (721) for compressing and decompressing data.

ABSTRACT

The invention relates to a method for transferring data from
a first switch to a second switch selectively by line-
switching or by packet-switching as well as to a switch for
carrying out the method.   Data packets are thereby first
transferred packet-switched through a packet-switching
network to the second switch.   With the presence of a
corresponding control signal a line-switching connection is
established from the first switch to the second switch and
the data are then transferred through this connection.
Where applicable a renewed change over to a packet-switching
transfer is carried out.   The invention allows a flexible
packet-switching or line-switching data transfer linked with
dynamic costs between the junctions of a telecommunications
network and provides the conditions for a cost-effective
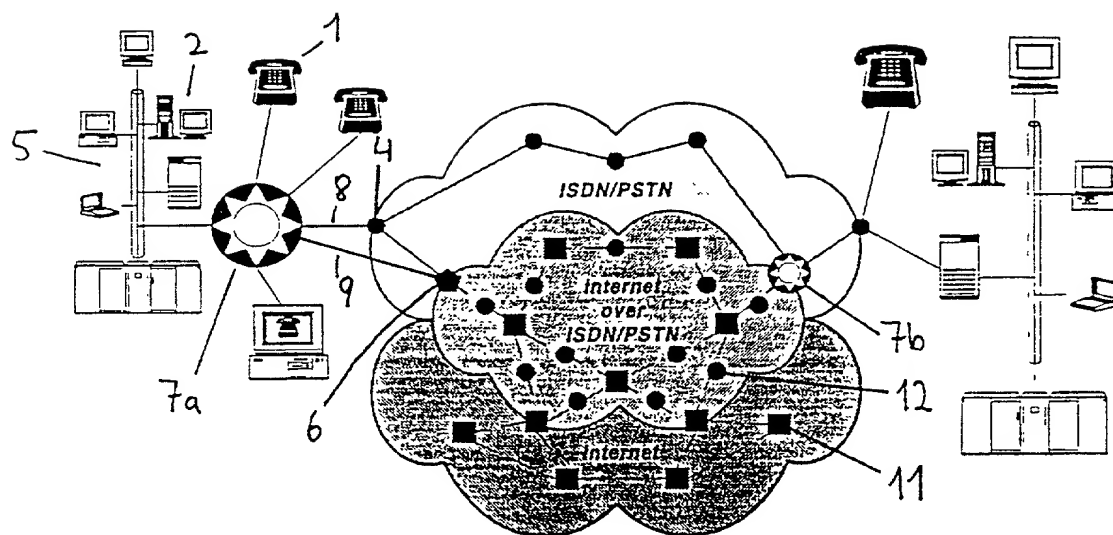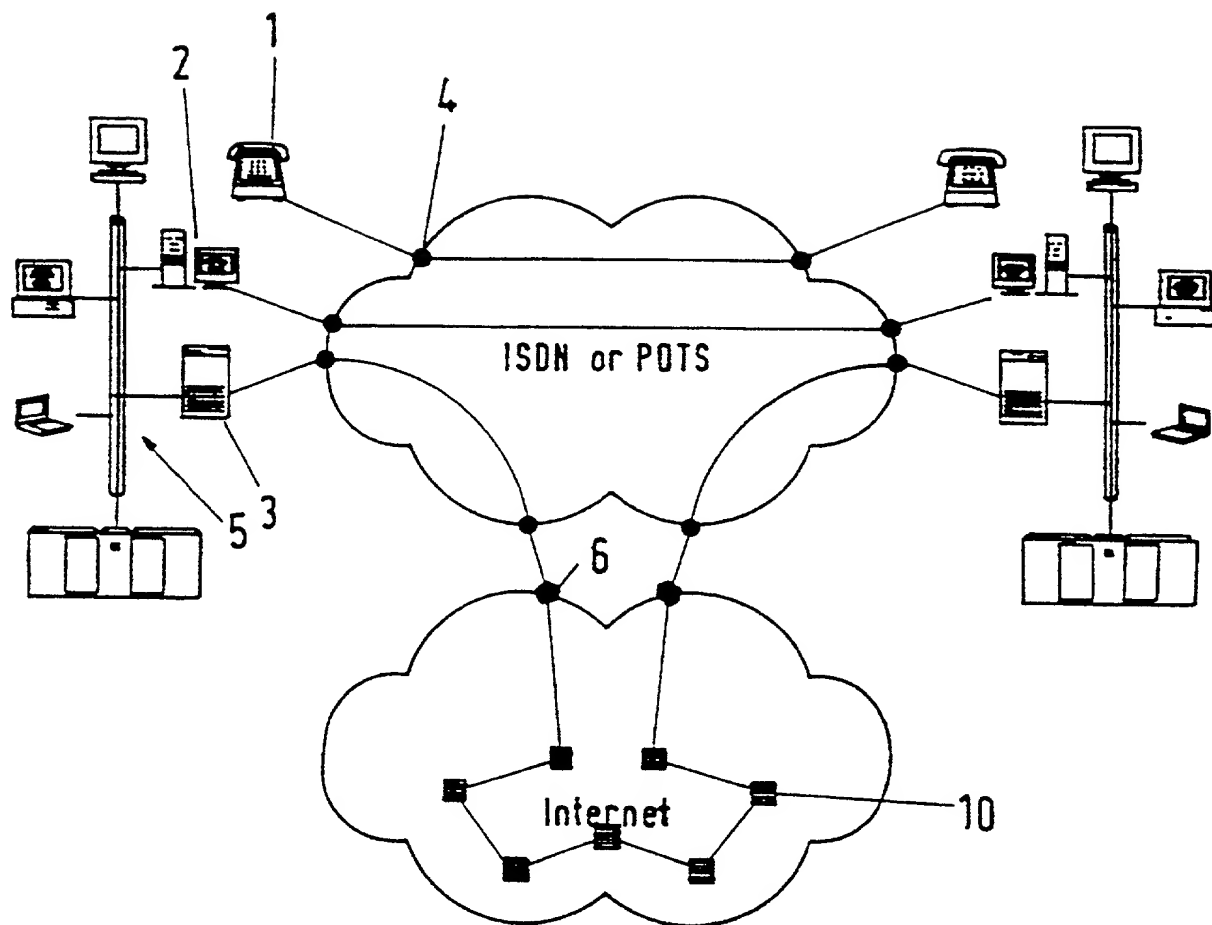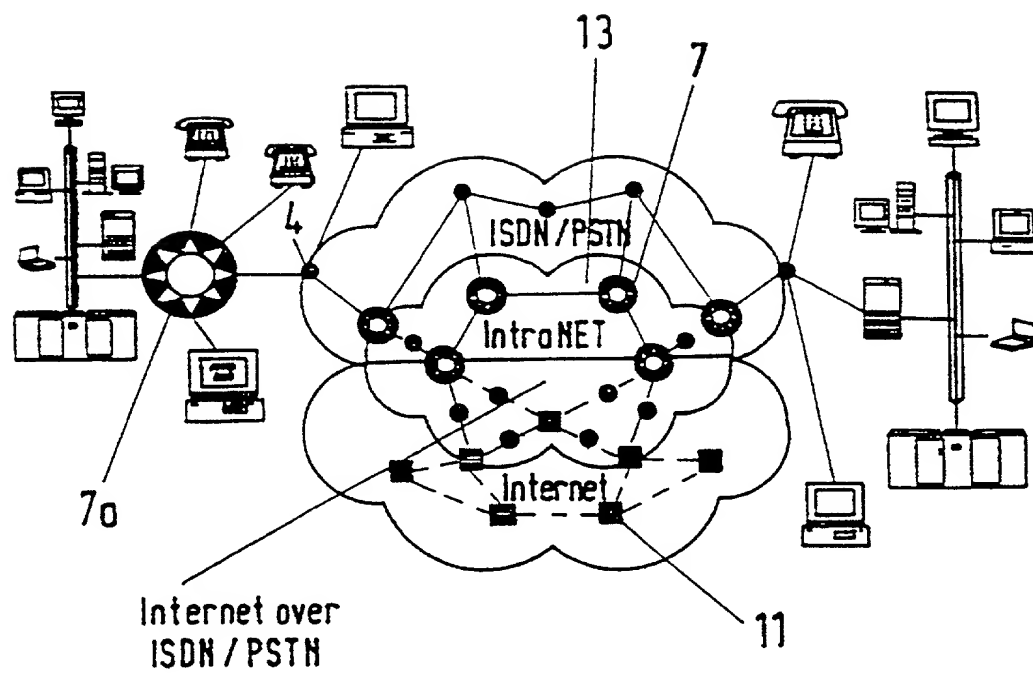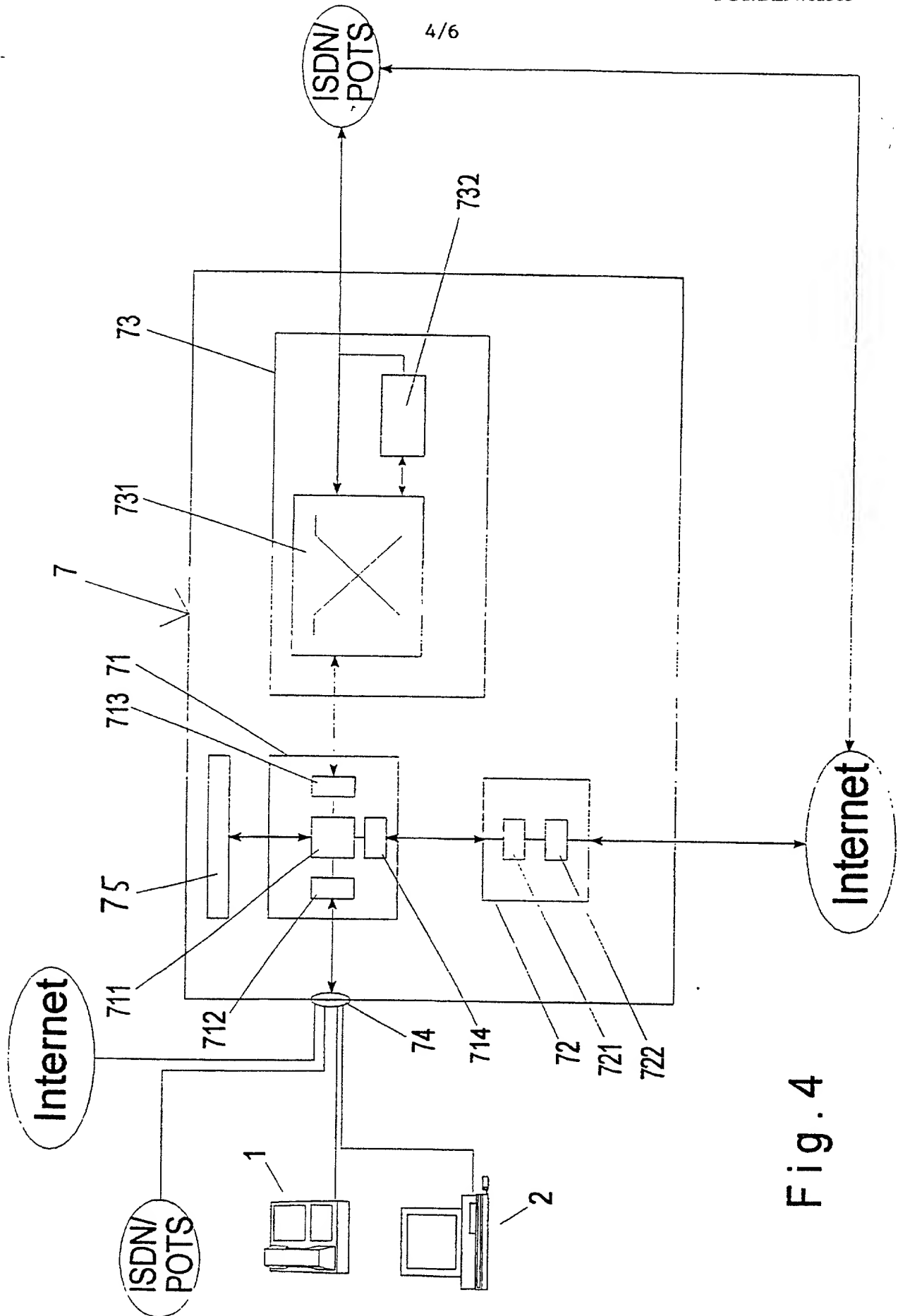data transfer with real time properties.

Fig. 1

Fig.2

Fig.3

4/6

Fig. 4

5/6

```
┌─────────────────────────────────┐
│   Versenden von IP-Paketen      │
└─────────────────────────────────┘
              │
       Nein  ╱ Steuersignal? ╲
        ─────┤               │
              ╲             ╱
               │ Ja
┌─────────────────────────────────┐
│ Aufbau leitungsvermittelte      │
│ Verbindung zu and. Switch       │
└─────────────────────────────────┘
              │
┌─────────────────────────────────┐
│ Wechsel auf leitungsvermitt-    │
│ elte Übertragung                │
└─────────────────────────────────┘
              │
┌─────────────────────────────────┐
│ leitungsvermitt. Übertragung    │
└─────────────────────────────────┘
              │
       ╱ Subkanäle ? ╲    Ja   ┌──────────────────┐
       │              ├────────│ Aktivieren des   │
       ╲            ╱          │ Multiplexers     │
        │ Nein                 └──────────────────┘
        │                              │
   Nein ╱ Steuersignal? ╲     ┌──────────────────┐
   ─────┤               │     │ Reserviere nur   │
        ╲             ╱       │ jedes n-te       │
         │ Ja               │ Byte/bit         │
                              └──────────────────┘
```

F i g . 5a

Vergleiche Header IP-Pakete mit Datenbank

Ziel bekannt?

Nein

Ja

Suche Ziel-Switch in gleichem geographischen Bereich

Ermittle Zwischenknoten auf Weg zum Empfänger

Baue Bypass zu diesem Ziel-Switch auf

Suche ISDN-Nummern der Zwischenknoten

Übertrage IP-Pakete mit gleichem geographischen Ziel über Bypass zum gewählten Ziel-Switch

Baue Bypass zum entferntesten Zwischen-knoten auf

Baue ggf. Bypässe zu mehreren Ziel-Switchen auf, wobei jeweils nur geeignete IP-Pakete auf den Bypässen übertragen werden

Übertrage IP-Pakete auf Bypass zu diesem Zwischenknoten
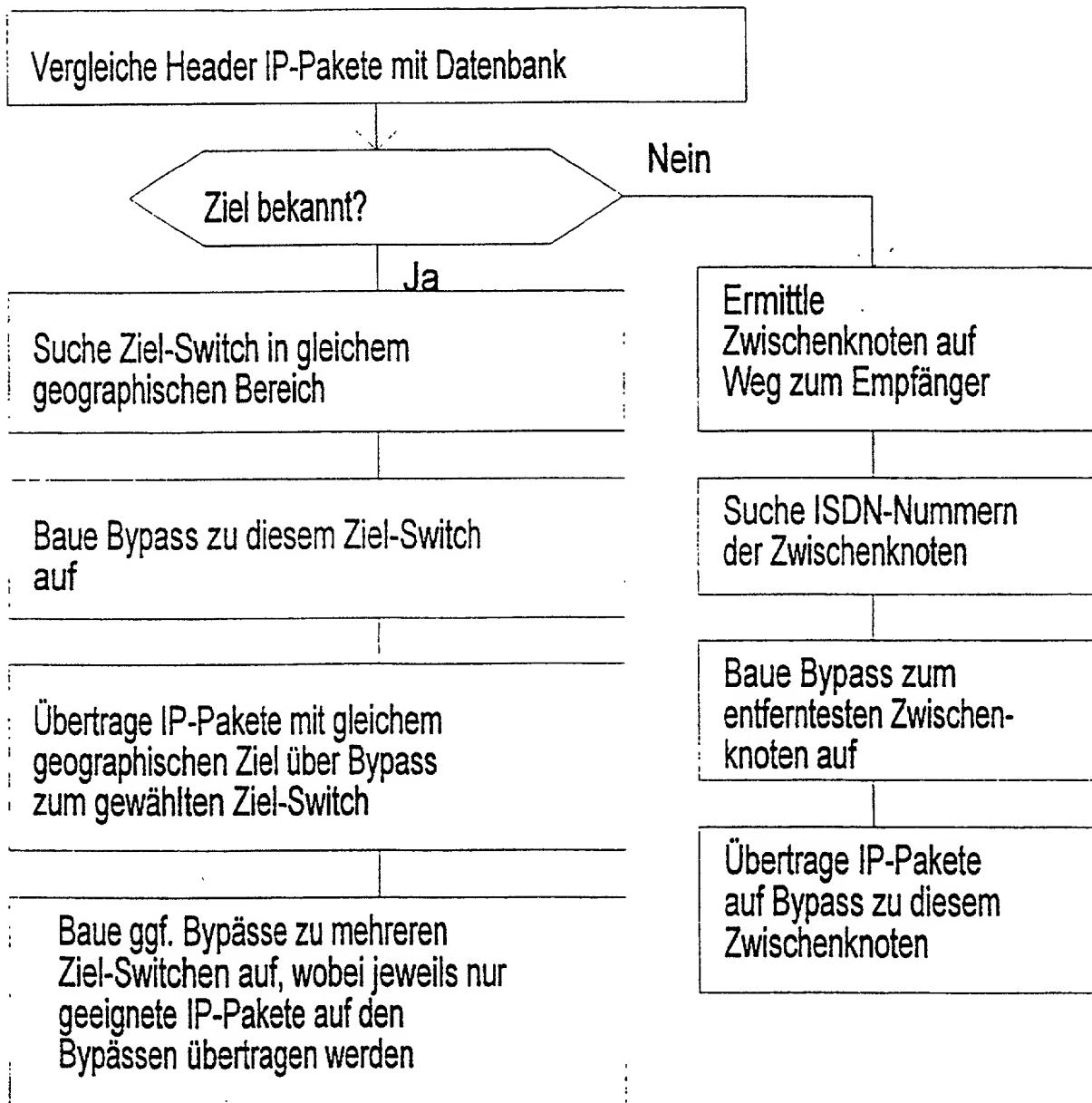
Fig.5b

DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATIONS   PATENT

Docket No. :   34248/DBP/M521

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled METHOD FOR TRANSMITTING DATA IN A TELECOMMUNICATIONS NETWORK AND SWITCH FOR IMPLEMENTING SAID METHOD, the specification of which is attached hereto unless the following is checked:

X   was filed on __7-October-1997__ as United States Application Number or PCT International Application Number __PCT/DE97/02363__ and was amended on __5-October-1998 and 30-October-1998__ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. § 119(a)-(d) or § 365(b) of the foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)

Application Number	Country	Filing Date (day/month/year)	Priority Claimed
196 42 063.6	Germany	7-October-1996	Yes
196 45 368.2	Germany	23-October-1996	Yes

I hereby claim the benefit under 35 U.S.C. § 119(e) of any United States provisional application(s) listed below.

Application Number   Filing Date

I hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s), or any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

Application Number   Filing Date   Patented/Pending/Abandoned

POWER OF ATTORNEY: I hereby appoint the following attorneys and agents of the law firm CHRISTIE, PARKER & HALE, LLP to prosecute this application and any international application under the Patent Cooperation Treaty based on it and to transact all business in the U.S. Patent and Trademark Office connected

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FOR PATENT APPLICATIONS
Docket No. 34248/DBP/M521

with either of them in accordance with instructions from the assignee of the entire interest in this application; or from the first or sole inventor named below in the event the application is not assigned; or from _Maikowski & Ninnemann_ in the event the power granted herein is for an application filed on behalf of a foreign attorney or agent.

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I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

_1-0 0_

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DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATIONS

Docket No. 34248/DBP/M521

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SFC PAS175570.1-*-3/9/99 9:11 am

-3-